PHILIPPINE
JOURNAL
OF
SCIENCE

# THE PHILIPPINE JOURNAL OF SCIENCE

## VOLUME 76

SEPTEMBER, OCTOBER, 1941
AUGUST, 1944 AND APRIL, 1947

WITH 23 PLATES AND 11 TEXT FIGURES

MANILA
BUREAU OF PRINTING
1947

## EDITORIAL BOARD

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## No. 1, September, 1941

[Issued October, 1941.]



## No. 2, October, 1941

[Issued November, 1941.]



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[Issued August 4, 1944]

**No. 4, April, 1947**

[Issued May 24, 1947.]

# THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 76 SEPTEMBER, 1941 No. 1


## THE INFLUENCE OF HYDROGEN-ION CONCENTRATION ON THE FIXATION OF SOME PHILIPPINE VEGETABLE TANNING EXTRACTS BY HIDE POWDER


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THREE TEXT FIGURES

In a previous article we reported the diffusion characteristics of some Philippine vegetable tanning extracts which have possible commercial value.(2)

Vegetable tanning is the process of rendering raw animal skin nonputrescible by bringing it in contact with the aqueous extract of parts of plants that contain tannins. The degree of tannage is essentially the result of two factors, the rate of diffusion of the tannins into the skin and the rate of fixation of tannins by the skin protein. Evidently the tanning process is not complete unless the tannins have fully penetrated the skin, but the character of the leather is markedly influenced by the degree and uniformity of fixation by tannins throughout the skin.

Fixation is the chemical or physicochemical combination of the hide substance with the tannins which diffuse through its fibers.

The studies recorded in this paper were undertaken to determine the fixation characteristics of the vegetable tanning materials which were previously employed in our diffusion experiments. The fixation experiments were carried out under different pH conditions. A study of both the diffusion and fix-

ation characteristics of tanning materials is of basic importance to the tanner.

## EXPERIMENTAL PROCEDURE

Extracts from the following Philippine vegetable tanning materials were used: Anabiong [*Trema orientalis* (Linn.) Blume], bakauan (*Rhizophora candelaria* DC), betel nut (*Areca catechu* Linn.), bitaog (*Calophyllum inophyllum* Linn.), kalumpit (*Terminalia edulis* Blanco), kamachile [*Pithecolobium dulce* (Roxb.) Benth.], and Philippine black wattle (*Acacia decurrens* Willd.). For comparison, imported extracts of quebracho (*Quebrachia Lorzentzii* (Griseb.), myrobalan (*Terminalia cebula* Retz.), and black wattle were also used. The analyses of these extracts have been given in the article cited above.

The hide powder used in this investigation was made by the Standard Manufacturing Company, Ridgway, Pennsylvania. It was first passed through a 100-mesh sieve to remove the fine dust that would be lost in the subsequent filtration through linen bags.

The powder was then thoroughly extracted with chloroform to remove the fat, and finally air-dried. The moisture in this stock sample was determined by drying the powder in a vacuum oven at 100°C. for 5 hours. All weights of the hide powder are reported on this moisture-free basis.

The general principle of the Wilson-Kern(11) method for tannin determination was employed for our fixation experiments. This method is based on the definition of tanning material as that portion of water-soluble matter in vegetable substances which precipitates gelatin from solution, and also forms with hide substance compounds resistant to washing with water.

The older methods for the determination of the tannin content of an extract consist in measuring the change in concentration of the tanning liquor before and after shaking with hide powder. These methods are subject to large errors due to the well-established fact that the hide powder removes not only tannins but also some nontannins from tanning solutions. This error is avoided in the Wilson-Kern method because the nontannins, which do not combine with the hide substance, are removed in washing the fixed hide powder. Furthermore, the tannin content of an extract, as determined by the older methods, varies with the acidity of the solutions, as shown by Thompson,

Seshachalam, and Hassan.(9) However, with the Wilson-Kern method the pH value appears to have no effect upon the determination of tannin content over the range of 3.6 to 7.3.(12)

Our experimental procedure for tannin fixation was a modification of the Wilson-Kern method and also of the process of Thomas and Kelly.(6) It consisted in measuring the increase in weight of a hide powder sample after fixation, thorough washing and drying. An excess of tanning material was necessary to make sure that all of the hide powder was fixed by the tannin.

In all the experiments, 2-gram samples (dry basis) of the specially prepared hide powder were placed in wide-mouthed 300-cc bottles. To these were added 100-cc portions of tanning solutions (about 2 per cent total solids) having different pH values.

Adjustment of the solutions to the desired hydrogen-ion concentration was made previously by the addition of calculated amounts of either 0.1 N $H_2SO_4$ or 0.1 N NaOH. After the addition of acid or alkali the solutions were set aside for at least 24 hours before the pH values were determined with a glass electrode type of pH meter.

The tightly covered bottles were shaken mechanically for 24 hours at room temperature (20° to 30°C.). The tanned hide powder was filtered in linen bags and washed with distilled water. Washing was continued for at least 4 hours, at decantation intervals of 20 minutes, until the wash water was free from tannins as detected by the gelatin salt reagent. Thomas and Frieden (4) claim that this test has a delicacy of 1 part tannin in 100,000 parts of solution.

The fixed hide powder was transferred to a weighed Gooch crucible matted with asbestos. It was then air dried for a day or so to remove most of the water. Next it was heated in a drying oven at 70°C. for 5 hours and finally the last traces of moisture were removed by heating in a vacuum oven at 100°C. for about 5 hours. The increase in weight (dry basis) of the hide powder represented the amount of tannins fixed by the hide powder.

Thomas and Kelly(6) showed that hydrolysis of hides occurring at the extremes of pH 1.0 and 11.0 may be disregarded when tannage is accomplished in short periods. The same workers also showed that washing the fixed hide powder with buffer

solution having a pH identical with that of the tanning solution used gives slightly different results from those of hide powder washed with distilled water alone.

Longer periods of washing were also tried, and although the fixed hide powder suffered no decomposition as tested by Stiasny's method,(3) the results showed no decided advantage over the shorter periods of washing.

## DISCUSSION OF RESULTS

Tables 1 to 10 show the degree of fixation of the tannins of different extracts by hide powder at different pH values after 24 hours of contact. These figures are indicated graphically in text figs. 1 to 3.

TABLE 1.—*Fixation of anabiong tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 1.00 | 1.249 | 66.4 |
| 1.50 | 1.010 | 53.7 |
| 1.90 | 0.973 | 51.8 |
| 2.50 | 1.261 | 67.0 |
| 3.00 | 1.113 | 59.2 |
| 3.40 | 1.135 | 60.4 |
| 4.00 | 1.079 | 57.4 |
| 4.50 | 1.021 | 54.3 |
| 5.00 | 0.974 | 51.8 |
| 5.50 | 0.792 | 42.1 |
| 5.75 | 0.810 | 43.1 |
| 6.00 | 1.086 | 57.8 |
| 6.50 | 0.994 | 52.9 |
| 7.00 | 0.956 | 50.9 |
| 7.50 | 1.175 | 62.5 |
| 8.10 | 1.443 | 76.8 |
| 8.50 | 1.179 | 62.7 |
| 9.00 | 0.978 | 52.0 |
| 9.50 | 0.926 | 49.3 |

NOTE.—The anabiong tanning extract contained 1.88 per cent of total solids.

Text figs. 1 to 3 show that the different tanning extracts studied have characteristic rates of fixation at different pH values. In all of the experiments there was a maximum fixation at pH 2.0 to 3.0 and a minimum at around pH 5.0 on the acid side. On the alkaline side the tanning extracts had another maximum fixation at pH 7.0 to 8.0. When the pH was higher than 9.0 there was a drop in the fixation curves.

TABLE 2.—*Fixation of bakauan tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.60 | 0.393 | 22.2 |
| 0.80 | 0.485 | 27.4 |
| 1.00 | 0.607 | 34.3 |
| 1.50 | 0.641 | 36.2 |
| 1.70 | 0.730 | 41.2 |
| 2.00 | 0.481 | 27.2 |
| 2.50 | 0.320 | 18.1 |
| 3.00 | 0.281 | 15.9 |
| 3.50 | 0.251 | 14.2 |
| 4.00 | 0.230 | 13.0 |
| 4.50 | 0.222 | 12.5 |
| 5.00 | 0.217 | 12.3 |
| 5.50 | 0.211 | 11.9 |
| 5.70 | 0.274 | 15.5 |
| 6.00 | 0.250 | 14.1 |
| 6.30 | 0.256 | 14.5 |
| 6.50 | 0.226 | 12.8 |
| 6.70 | 0.267 | 15.1 |
| 7.00 | 0.258 | 14.6 |
| 7.50 | 0.264 | 14.9 |
| 8.00 | 0.306 | 17.3 |
| 8.50 | 0.346 | 19.5 |
| 9.00 | 0.345 | 19.5 |
| 9.50 | 0.308 | 17.4 |

NOTE.—The bakauan tanning extract contained 1.77 per cent of total solids.

TABLE 3.—*Fixation of betel-nut tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.75 | 0.473 | 24.5 |
| 1.00 | 0.834 | 43.2 |
| 1.50 | 0.898 | 46.5 |
| 1.75 | 0.834 | 43.2 |
| 2.00 | 0.985 | 51.0 |
| 2.50 | 0.961 | 49.8 |
| 3.00 | 0.559 | 29.0 |
| 3.40 | 0.422 | 21.9 |
| 4.00 | 0.636 | 33.0 |
| 4.50 | 0.370 | 19.2 |
| 5.00 | 0.327 | 16.9 |
| 5.50 | 0.254 | 13.2 |
| 6.15 | 0.557 | 28.9 |
| 6.85 | 0.731 | 37.9 |
| 7.00 | 0.694 | 36.0 |
| 7.50 | 0.528 | 27.4 |
| 8.00 | 0.514 | 26.6 |
| 8.50 | 0.500 | 25.9 |
| 9.30 | 0.411 | 21.3 |

NOTE.—The betel-nut tanning extract contained 1.93 per cent of total solids.

TABLE 4.—*Fixation of bitaog tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.90 | 0.539 | 28.5 |
| 1.30 | 0.575 | 30.4 |
| 1.50 | 0.534 | 28.3 |
| 1.80 | 0.581 | 30.7 |
| 2.50 | 0.699 | 37.0 |
| 3.00 | 0.557 | 29.5 |
| 3.50 | 0.462 | 24.4 |
| 4.00 | 0.396 | 21.0 |
| 4.25 | 0.351 | 18.6 |
| 4.40 | 0.298 | 15.8 |
| 4.70 | 0.351 | 18.6 |
| 5.00 | 0.324 | 17.1 |
| 5.30 | 0.395 | 20.9 |
| 5.50 | 0.261 | 13.8 |
| 6.00 | 0.450 | 23.8 |
| 6.50 | 0.458 | 24.2 |
| 7.00 | 0.563 | 29.8 |
| 7.50 | 0.590 | 31.2 |
| 8.00 | 0.540 | 28.6 |
| 8.50 | 0.640 | 33.9 |
| 8.80 | 0.594 | 31.4 |
| 9.50 | 0.522 | 27.6 |
| 10.00 | 0.463 | 24.5 |
| 10.70 | 0.223 | 11.8 |

NOTE.—The bitaog tanning extract contained 1.89 per cent of total solids.

TABLE 5.—*Fixation of imported black-wattle tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.60 | 0.718 | 48.8 |
| 1.20 | 0.876 | 59.6 |
| 1.60 | 0.879 | 59.8 |
| 2.00 | 0.934 | 63.5 |
| 2.60 | 0.918 | 62.4 |
| 3.00 | 0.904 | 61.5 |
| 3.50 | 0.789 | 53.7 |
| 4.00 | 0.771 | 52.4 |
| 4.50 | 0.732 | 49.8 |
| 5.00 | 0.704 | 50.6 |
| 5.50 | 0.738 | 50.2 |
| 6.00 | 0.736 | 50.1 |
| 6.50 | 0.757 | 51.5 |
| 7.00 | 0.795 | 54.1 |
| 7.50 | 0.698 | 47.5 |
| 8.00 | 0.639 | 43.5 |

NOTE.—The imported black-wattle tanning extract contained 1.47 per cent of total solids.

TABLE 6.—*Fixation of Philippine black-wattle tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.50 | 0.828 | 46.8 |
| 1.00 | 0.931 | 52.6 |
| 1.20 | 0.911 | 51.5 |
| 1.50 | 0.900 | 50.8 |
| 2.00 | 0.893 | 50.5 |
| 2.50 | 0.798 | 45.1 |
| 3.00 | 0.558 | 31.5 |
| 3.50 | 0.479 | 27.1 |
| 3.70 | 0.394 | 22.3 |
| 4.00 | 0.405 | 22.9 |
| 4.30 | 0.405 | 22.9 |
| 4.50 | 0.423 | 23.9 |
| 4.70 | 0.399 | 22.5 |
| 5.00 | 0.412 | 23.3 |
| 5.20 | 0.383 | 21.6 |
| 5.50 | 0.436 | 24.6 |
| 6.00 | 0.386 | 21.8 |
| 6.50 | 0.408 | 23.1 |
| 7.00 | 0.428 | 24.2 |
| 7.50 | 0.426 | 24.1 |
| 8.00 | 0.500 | 28.2 |
| 8.50 | 0.447 | 25.3 |
| 9.00 | 0.444 | 25.1 |

NOTE.—The Philippine black-wattle tanning extract contained 1.77 per cent of total solids.

TABLE 7.—*Fixation of kalumpit tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.50 | 0.709 | 34.3 |
| 1.00 | 0.701 | 33.9 |
| 1.50 | 0.820 | 39.6 |
| 1.70 | 0.802 | 38.7 |
| 2.00 | 0.724 | 35.0 |
| 2.50 | 0.494 | 23.9 |
| 3.00 | 0.463 | 22.4 |
| 3.50 | 0.456 | 22.0 |
| 4.00 | 0.467 | 22.6 |
| 4.30 | 0.531 | 25.7 |
| 4.50 | 0.440 | 21.3 |
| 5.00 | 0.435 | 21.0 |
| 5.50 | 0.333 | 16.1 |
| 5.70 | 0.464 | 22.4 |
| 6.00 | 0.455 | 22.0 |
| 6.50 | 0.407 | 19.7 |
| 6.80 | 0.291 | 14.1 |
| 7.00 | 0.323 | 15.6 |
| 7.50 | 0.264 | 12.8 |
| 7.80 | 1.992 | 96.2 |
| 8.00 | 1.722 | 83.2 |
| 8.50 | 1.764 | 85.2 |

NOTE.—The kalumpit tanning extract contained 2.07 per cent of total solids.

TABLE 8.—*Fixation of kamachile tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.80 | 0.477 | 25.1 |
| 1.20 | 0.593 | 31.2 |
| 1.50 | 0.761 | 40.0 |
| 1.60 | 0.671 | 35.3 |
| 2.00 | 0.630 | 33.2 |
| 2.40 | 0.604 | 31.8 |
| 3.00 | 0.531 | 27.9 |
| 3.60 | 0.477 | 25.1 |
| 4.10 | 0.465 | 24.5 |
| 4.40 | 0.475 | 25.0 |
| 4.50 | 0.524 | 27.6 |
| 4.80 | 0.492 | 25.9 |
| 5.00 | 0.458 | 24.1 |
| 5.50 | 0.531 | 27.9 |
| 6.00 | 0.455 | 23.9 |
| 6.50 | 0.462 | 24.3 |
| 7.00 | 0.441 | 23.2 |
| 7.50 | 0.402 | 21.2 |
| 8.00 | 0.281 | 14.8 |
| 8.50 | 0.334 | 17.6 |
| 9.00 | 0.314 | 16.5 |
| 9.50 | 0.272 | 14.3 |

NOTE.—The kamachile tanning extract contained 1.90 per cent of total solids.

TABLE 9.—*Fixation of myrobalan tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 1.22 | 0.119 | 6.5 |
| 1.70 | 0.250 | 13.6 |
| 2.10 | 0.355 | 19.3 |
| 2.48 | 0.471 | 25.6 |
| 3.00 | 0.494 | 26.8 |
| 3.42 | 0.452 | 24.5 |
| 4.00 | 0.356 | 19.3 |
| 4.50 | 0.300 | 16.3 |
| 5.20 | 0.096 | 5.2 |
| 5.50 | 0.184 | 10.0 |
| 6.10 | 0.137 | 7.4 |
| 6.50 | 0.148 | 8.0 |
| 7.00 | 0.093 | 5.1 |
| 7.50 | 0.061 | 3.3 |
| 8.00 | 0.027 | 1.5 |
| 8.50 | 0.016 | 0.9 |
| 9.00 | 0.017 | 0.9 |
| 10.00 | 0.004 | 0.2 |

NOTE.—The myrobalan tanning extract contained 1.84 per cent of total solids.

TABLE 10.—*Fixation of quebracho tanning extract by hide powder.*

| pH of tanning solution. | Tannin fixed by 2 grams of hide powder in 24 hours. | Fixation. |
|---|---|---|
| | *g.* | *Per cent.* |
| 0.65 | 1.008 | 61.1 |
| 0.80 | 1.033 | 62.6 |
| 1.00 | 1.003 | 60.8 |
| 1.30 | 0.993 | 60.2 |
| 1.55 | 0.980 | 59.4 |
| 2.00 | 0.982 | 59.5 |
| 2.30 | 0.930 | 56.4 |
| 2.70 | 0.630 | 38.2 |
| 3.25 | 0.613 | 37.2 |
| 3.60 | 0.504 | 30.5 |
| 4.10 | 0.492 | 29.8 |
| 4.50 | 0.497 | 30.1 |
| 4.75 | 0.542 | 32.8 |
| 5.00 | 0.469 | 28.4 |
| 5.30 | 0.465 | 28.2 |
| 6.00 | 0.671 | 40.7 |
| 6.50 | 0.541 | 32.8 |
| 7.00 | 0.674 | 40.8 |
| 7.40 | 0.689 | 41.8 |
| 7.75 | 0.696 | 42.2 |
| 8.00 | 0.735 | 44.5 |
| 8.50 | 0.618 | 37.5 |
| 9.20 | 0.312 | 18.9 |
| 9.50 | 0.159 | 9.6 |

NOTE.—The quebracho tanning extract contained 1.65 per cent of total solids.

The isoelectric point of collagen has been established to be at pH 5.0 by Thomas and Kelly,(7) using the dye fixation method, and by Porter,(3) using the degree of swelling as indicator. The latter, working with the pH range 0.3 to 11.9, found a minimum at pH 4.8, and maxima appearing at pH 2.2 and at pH 12.5. Wilson and Gallum,(9) in a study of the plumping of calfskin at 7°C., as a function of hydrogen-ion concentration, observed two minima of plumping, at pH 5.1 and at pH 7.6. They suggested that these two points represent the isoelectric points of two different forms of collagen undergoing a change in form, possibly an internal rearrangement, in passing from acid to alkaline solutions. Wilson and Kern(13) also found two minima, not far from the values obtained by Wilson and Gallum, at pH 4.7 (the generally accepted isoelectric point) and at pH 7.7. At these points they believe that gelatin exists in the gel and sol forms, respectively.

Thomas and Foster(8) have found that vegetable tannins are amphoteric in character, with the isoelectric point lying around

pH 2.0 to 2.5, being negatively charged when the hydrogen-ion concentration falls below this figure and positively charged in a more acid solution.

All these factors have bearing on the explanation of the curves obtained. Furthermore, the somewhat wavy form of the lines is characteristic of the short period of fixation as shown in a similar report of Thomas and Kelly,(6) the breaks being more or less straightened as the period of fixation is lengthened.

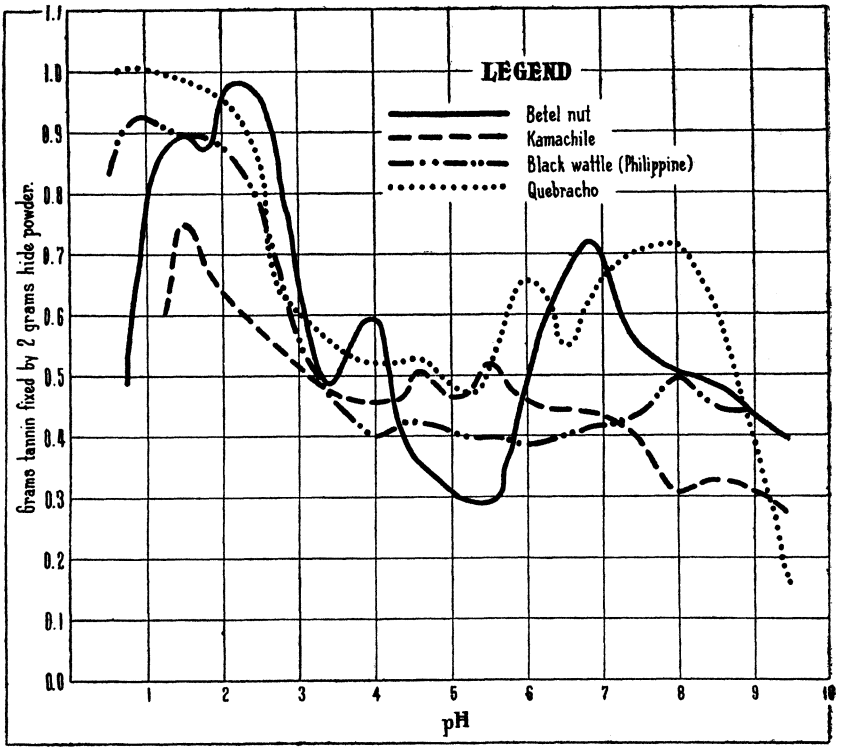


FIG. 1. Grams of betel-nut, kamachile, Philippine black-wattle, and quebracho tannins fixed by 2 grams hide powder at different pH values.

In our reported work on diffusion we found that the order of increasing rate of diffusion of the tans studied was as follows: Philippine black wattle<kamachile<bakauan<anabiong<imported black wattle<bitaog<quebracho<kalumpit<betel nut<myrobalan.

Based on their increasing nontannin : nontannin + tannin ratios, they were arranged as follows: kalumpit<quebracho<Philippine black wattle<imported black wattle< bitaog< bakauan<betel nut<myrobalan<kamachile<anabiong.

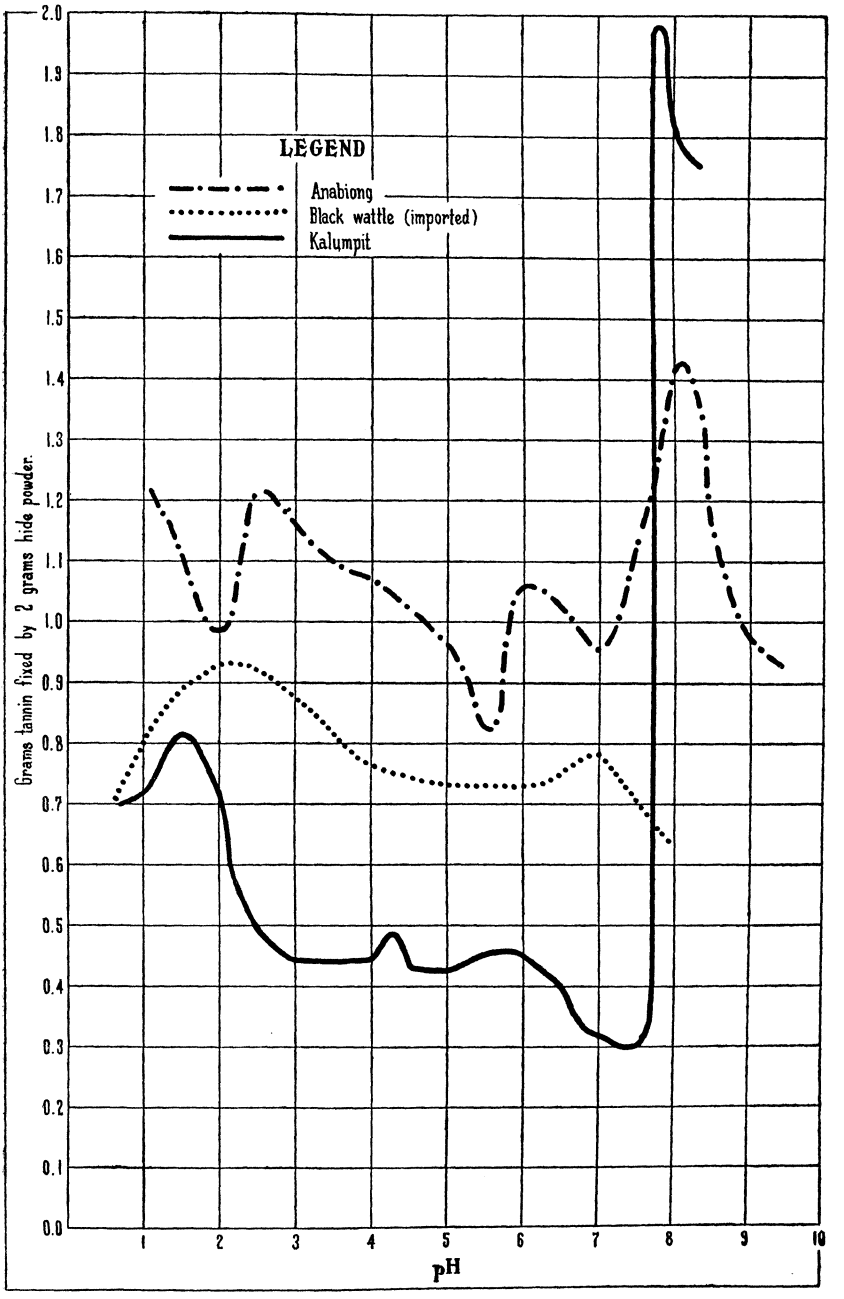


FIG. 2. Grams of anabiong, imported black-wattle, and kalumpit tannins fixed by 2 grams hide powder at different pH values.

For the purpose of comparing the fixation and diffusion characteristics of the vegetable tanning materials under investigation, we have grouped the rates of fixation under the following separate ranges: below pH 3.0, between pH values 3.0 and 5.0, and above pH 5.0 (Table 11). The degree of fixation is given in grams of tannin fixed by 2 grams of hide powder. In Table 11 the names of the tanning extracts are arranged in the order of increasing rate of diffusion as observed in the reported diffusion experiments.

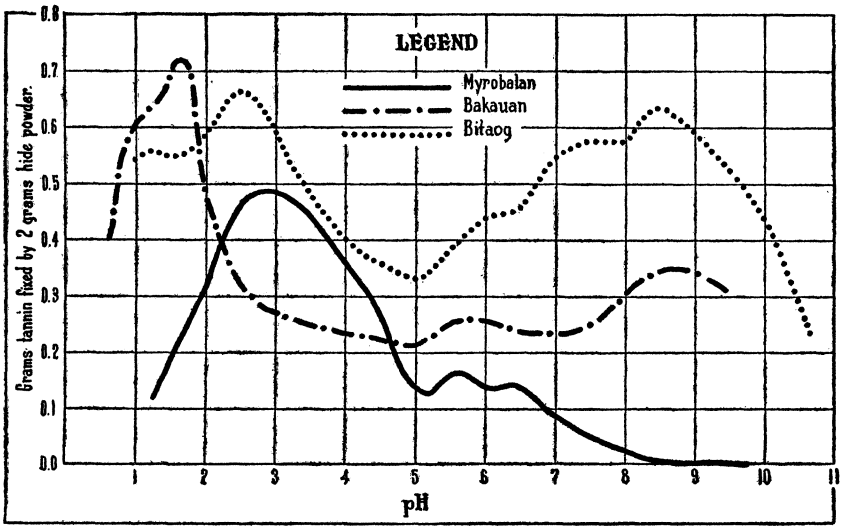


FIG. 3. Grams of myrobalan, bakauan, and bitaog tannins fixed by 2 grams hide powder at different pH values.

In Table 12 the degree of fixation of the tannin is expressed in percentage. The order of increasing rate of diffusion is determined by experiments on the diffusion, and the order of decreasing rate of fixation is based on averages of fixation values at the different ranges of pH.

Philippine black wattle, kamachile, and anabiong exhibited similar fixation characteristics, having maximum fixation below pH 3.0 and minimum above pH 5.0. Bakauan, bitaog, and betel nut may be grouped with quebracho with maximum fixation below pH 3.0 and minimum between pH 3.0 and 5.0.

Imported black wattle and myrobalan have their highest fixation between pH 3.0 and 5.0 and their lowest above pH 5.0. The reverse characteristic was exhibited by kalumpit as shown by its maximum fixation above pH 5.0 and its minimum between pH 3.0 and 5.0.

TABLE 11.—*Fixation of different tanning extracts.*

| Tanning extract. | Fixation. | | | | | |
|---|---|---|---|---|---|---|
| | Below pH 3.0. | | | Between pH 3.0 and 5.0. | | |
| | Minimum. | Maximum. | Average. | Minimum. | Maximum. | Average. |
| | *g.* | *g.* | *g.* | *g.* | *g.* | *g.* |
| Philippine black wattle | 0.798 | 0.931 | 0.877 | 0.394 | 0.558 | 0.434 |
| Kamachile | 0.477 | 0.761 | 0.622 | 0.465 | 0.531 | 0.488 |
| Bakauan | 0.393 | 0.730 | 0.522 | 0.217 | 0.281 | 0.240 |
| Anabiong | 0.973 | 1.261 | 1.123 | 0.974 | 1.135 | 1.064 |
| Imported black wattle | 0.718 | 0.934 | 0.865 | 0.732 | 0.904 | 0.788 |
| Bitaog | 0.534 | 0.699 | 0.586 | 0.298 | 0.462 | 0.392 |
| Quebracho | 0.630 | 1.033 | 0.947 | 0.469 | 0.613 | 0.519 |
| Kalumpit | 0.494 | 0.820 | 0.708 | 0.435 | 0.531 | 0.465 |
| Betel nut | 0.473 | 0.985 | 0.830 | 0.327 | 0.636 | 0.463 |
| Myrobalan | 0.119 | 0.471 | 0.299 | 0.300 | 0.356 | 0.400 |

| Tanning extract. | Fixation. | | | Average fixation at different pH values. |
|---|---|---|---|---|
| | Above pH 5.0. | | | |
| | Minimum. | Maximum. | Average. | |
| | *g.* | *g.* | *g.* | *g.* |
| Philippine black wattle | 0.383 | 0.500 | 0.429 | 0.580 |
| Kamachile | 0.272 | 0.531 | 0.385 | 0.498 |
| Bakauan | 0.211 | 0.346 | 0.276 | 0.346 |
| Anabiong | 0.792 | 1.443 | 1,034 | 1.073 |
| Imported black wattle | 0.639 | 0.744 | 0.727 | 0.793 |
| Bitaog | 0.223 | 0.640 | 0.479 | 0.485 |
| Quebracho | 0.159 | 0.735 | 0.556 | 0.674 |
| Kalumpit | 0.264 | 1.922 | 0.801 | 0.658 |
| Betel nut | 0.254 | 0.731 | 0.524 | 0.605 |
| Myrobalan | 0.004 | 0.184 | 0.078 | 0.259 |

Table 12 shows no clear-cut relation between the rates of fixation and of diffusion of the vegetable tans under study. However, the theory that the more easily diffused tan is the less astringent or less fixed, and vice versa, holds true in the case of bitaog, kalumpit, and myrobalan.

Generally tanning materials that diffuse fast and fix slowly are most suitable for initial tanning in union tannage. Materials that have fair fixation and diffusion characteristics may be used for all kinds of leather, and those that have slow or fair diffusion and fast fixation properties are most suitable for light leather tannage and also for final tanning in union tannage. Taking these points into consideration, Table 12 shows that Philippine black wattle, anabiong, and imported black wattle are most suitable for tanning light leather and for final

TABLE 12.—*Fixation of different tanning extracts.*

| Tanning extract. | Fixation. | | | | | |
|---|---|---|---|---|---|---|
| | Below pH 3.0. | | | Between pH 3.0 and 5.0. | | |
| | Minimum. | Maximum. | Average. | Minimum. | Maximum. | Average. |
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Philippine black wattle | 45.1 | 52.6 | 49.5 | 22.3 | 31.5 | 24.5 |
| Kamachile | 25.1 | 40.0 | 32.7 | 24.1 | 27.9 | 25.7 |
| Bakauan | 18.1 | 41.2 | 29.5 | 12.3 | 15.9 | 13.6 |
| Anabiong | 51.8 | 67.1 | 59.0 | 51.8 | 60.4 | 56.6 |
| Imported black wattle | 48.8 | 63.5 | 46.8 | 49.8 | 61.5 | 53.5 |
| Bitaog | 28.3 | 37.0 | 30.9 | 17.1 | 29.5 | 20.8 |
| Quebracho | 38.1 | 62.5 | 57.2 | 28.3 | 37.1 | 31.4 |
| Kalumpit | 23.8 | 39.6 | 34.2 | 21.0 | 25.7 | 21.8 |
| Betel nut | 24.5 | 51.1 | 43.1 | 16.9 | 33.0 | 24.0 |
| Myrobalan | 6.4 | 25.6 | 16.3 | 16.3 | 26.9 | 21.8 |

| Tanning extract. | Fixation. | | | Order of— | |
|---|---|---|---|---|---|
| | Above pH 5.0. | | | Increasing rate of diffusion. | Decreasing rate of fixation. |
| | Minimum. | Maximum. | Average. | | |
| | *Per cent.* | *Per cent.* | *Per cent.* | | |
| Philippine black wattle | 21.6 | 28.2 | 24.2 | 1 | 4 |
| Kamachile | 14.3 | 27.9 | 20.4 | 2 | 6 |
| Bakauan | 11.9 | 19.5 | 15.5 | 3 | 9 |
| Anabiong | 42.1 | 76.8 | 55.0 | 4 | 1 |
| Imported black wattle | 43.5 | 51.5 | 49.1 | 5 | 2 |
| Bitaog | 11.8 | 33.9 | 25.1 | 6 | 7 |
| Quebracho | 9.6 | 44.5 | 33.6 | 7 | 3 |
| Kalumpit | 14.1 | 96.2 | 34.8 | 8 | 8 |
| Betel nut | 13.1 | 37.9 | 27.1 | 9 | 5 |
| Myrobalan | 0.2 | 10.0 | 4.2 | 10 | 10 |

tanning in union tannage. Anabiong and imported black wattle have almost identical characteristics.

Kamachile, the tanning material most commonly used in local tanneries, is a poor diffuser and fixer. This is probably the reason why an unpleasant odor is developed, due to decomposition of the undertanned leather. Bakauan, which has fixing and diffusing characteristics similar to those of kalumpit, may be used only for union tannage.

In diffusion bitaog is similar to quebracho but it is less astringent.

Kalumpit and myrobalan, which belong to the same genus, possess similar characteristics and should be good for preliminary tanning in union tannage.

Betel nut seems to be one of the most promising local tanning materials. Being a very good diffuser and a good fixer it can be used for all kinds of leather, light and heavy. Our tests show that it has the additional advantage of producing leather of a fine natural color.(1) While there are no large plantations of betel-nut palm, this plant can easily be cultivated.

The other Philippine tanning material which has possible commercial value is anabiong. This plant is found throughout the Islands at low and medium altitudes. It grows abundantly in deserted clearings and second-growth forests. The bark comes off easily from the trunk of the tree.

## SUMMARY

Fixation is the chemical or physicochemical combination of hide substance with the tannins which diffuse through its fibers.

Experiments made with Philippine and imported vegetable tanning materials to compare their rates of fixation under varying conditions of pH, show the following:

1. In general there seems to be no well-defined relationship between the rates of fixation and diffusion. However, the theory that the more easily diffused tan is the less astringent or less fixed and vice versa holds true in the case of bitaog, kalumpit, and myrobalan.

2. Philippine black wattle, anabiong, and imported black wattle, being poor diffusers and good fixers, may be used for light leather tannage and for final tanning in union tannage.

3. Kamachile and bakauan, being poor fixers and diffusers, should be suitable for union tannage.

4. In diffusion bitaog is similar to quebracho, but it is less astringent.

5. Kalumpit and myrobalan, being good diffusers and poor fixers, should be good only for preliminary tanning.

6. Of the Philippine tanning materials studied betel nut and anabiong seem to have promising commercial prospects. Betel nut is an excellent diffuser and a good fixer. Besides being suitable for all kinds of leather, it has the additional advantage of producing leather of a fine natural color. Anabiong grows abundantly in deserted clearings and second-growth forests. The bark is easily removed from the tree.

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# ILLUSTRATIONS

[Drawings by Francisco Rafael.]

# A SUMMARY OF KENTROCHROSIA LAUTERBACH AND SCHUMANN

By E. D. MERRILL and L. M. PERRY
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In a collection of plants recently received from the Philippine National Herbarium there is a representative of the apocynaceous genus *Kentrochrosia,* hitherto unreported as such from the Philippines. *Kentrochrosia* Lauterb. and K. Schum. was established on the basis of a single species, *K. monocarpa* Lauterb. and K. Schum., from northeastern New Guinea. Its distinguishing character is the strongly compressed and laterally spurred fruit as contrasted with the terete or only slightly compressed and spurless fruit of *Kopsia* Blume. The two genera have a common floral character in the presence of two disc scales, and, except in the fruits, are very similar in habit, inflorescence, and floral characters. As a matter of fact, Markgraf,[1] in discussing the status of *Kopsia flavida* Blume, a species based on a flowering specimen collected in New Guinea by Zippelius, pointed out that these two genera differ not at all in the floral characters but only in their very different fruits. By inference he concluded that *Kopsia flavida* Blume must be the same as *Kentrochrosia* Lauterb. and K. Schum. The question of priority of specific names evidently perplexed him; for shortly after,[2] he stated the case more explicitly, noting that, since no wild *Kopsia* was known from New Guinea, *Kopsia flavida* Blume must belong to *Kentrochrosia* Lauterb. and K. Schum. However, inasmuch as the original of Blume's species is only a flowering specimen, and *Kopsia* and *Kentrochrosia* are indistinguishable by the structure of the flowers, and since claims of priority can be established only on the basis of the fruit which is lacking, it would be unsafe to take up at this time the older specific name. In both his publications Markgraf indicated that the genus was endemic in New Guinea. Since then the range of *Kentrochrosia monocarpa* Lauterb. and K. Schum. has been found to extend eastward into the Solomon Islands and the New Hebrides. Fur-

[1] Nova Guinea 14 (1925) 284. [2] Bot. Jahrb. 61 (1927) 169.

ther, two other species belonging to this genus have appeared: *Kentrochrosia carolinensis* (Kaneh.) Kaneh. and Hatus.[3] from Palau Island, Micronesia, and *K. triangularis* (Quis. & Merr.) from Surigao Province, Mindanao, both originally described as species of *Kopsia.* Hence the genus, instead of being endemic in New Guinea, is another example to be added to the lists elaborated by Merrill in the discussion of floristic relationships of the Philippine flora.[4] In this detailed consideration of alliances between the individual units and various geographic regions, *Kentrochrosia* Lauterb. and K. Schum. obviously belongs in the list of some 40 entities found in the Philippines and in one or more of the islands to the south and southeast.

The following is a summary of the material in our herbarium:

**KENTROCHROSIA CAROLINENSIS (Kaneh.) Kanehira & Hatusima.**

*Kentrochrosia carolinensis* (Kaneh.) KANEHIRA & HATUSIMA, Bot. Mag. Tokyo 53 (1939) 190, *fig. 79.*

*Kopsia carolinensis* KANEHIRA, Bot. Mag. Tokyo 45 (1931) 344; Enum. Micron. Pl. (1935) 395.

CAROLINE ISLANDS, Palau, Gaspan, Aimiriik, Babeldoab, *Kanehira & Hatusima 4569.*

**KENTROCHROSIA MONOCARPA Lauterbach and Schumann.**

*Kentrochrosia monocarpa* LAUTERBACH and SCHUMANN, in K. Schum. & Lauterb. Fl. Deutsch. Schutzgeb. Südsee (1900) 506, *t. 18;* MARKGRAF, Nov. Guin. 14 (1925) 283; Bot. Jahrb. 61 (1927) 195; WHITE, Jour. Arnold Arb. 10 (1929) 262.

BRITISH NEW GUINEA, Ihu, Vailala River, *Brass 939,* rain forest: Wuroi, Oriomo River, *Brass 5789,* low river bank frequently covered by tidal backwater: Sturt Island, lower Fly River, *Brass 8135,* rain forest, common on muddy river banks; Fly River, 528-mile Camp, *Brass 6853,* altitude 80 meters, in undergrowth of river floodbank forest. SOLOMON ISLANDS, San Cristobal, Star Harbor, *Brass 3110,* coastal valley: Waimasi, *Brass 3145,* coastal swamps. NEW HEBRIDES, Santa Cruz, Vanikoro, *Kajewski 581,* rain forest (white corolla with pink center).

As far as we can say from flowering specimens alone, *Kajewski 581* is a good match for the other Pauasian material here cited. The habitats are similar. In all the specimens cited above, except *Kajewski 581,* the field notes indicate a shrub or small tree up to 4 meters, having showy white flowers with

[3] Bot. Mag. Tokyo 53 (1939) 190.

[4] Enum. Phil. Fl. Pl. 4 (1926) 77–105.

a red throat. In Guillaumin, A Florula of the Island of Espiritu Santo,[5] we believe the specimen listed as "*Kopsia fruticosa* A. DC.?,-Hog Harbor, rain forest; white flower, purple center; (274) 26.i.34," ought to be compared with this genus. Our surmise is that this specimen, which we have not seen, represents the same species as *Kajewski 581* from the New Hebrides, and that the latter is *Kentrochrosia monocarpa* Lauterb. and K. Schum.

**KENTROCHROSIA TRIANGULARIS (Quis. and Merr.) comb. nov.**

*Kopsia triangularis* QUISUMBING and MERRILL, Phil. Jour. Sci. 37 (1928) 191.

PHILIPPINE ISLANDS, MINDANAO, Surigao Province, *Wenzel 2648, 2706,* June and July, 1927; *Bur. Sci. 83386 Ramos and Convocar* from Lake Mainit, March–April, 1931.

The known generic range of the group is now Mindanao in the southern Philippines, New Guinea, Solomon Islands, the New Hebrides Islands, and the Caroline Islands (Palau). It is not unreasonable to expect its occurrence in such islands as Celebes, Gilolo, and perhaps in some islands of the Molucca group.

[5] Jour. Linn. Soc. Bot. 51 (1938) 556.

# MISCELLANEOUS FERNS OF NEW GUINEA [1]

By EDWIN B. COPELAND
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**MARATTIA BRASSII Copeland sp. nov.**

Rhachibus paleis deciduis ferrugineis et amorphis fibrillosis et rarioribus lanceolatis integris 2 mm longis sparsis, denique nudis, mollibus, superne in linea mediale nigris alibi brunneis, secundariis anguste brunneo-alatis; pinnulis sessilibus, maximis (in parte inferiore frondis) 15 cm longis, 16 mm latis, basi latere basiscopico rotundatis acroscopico late cuneatis, ubique argute serrulatis, supra mediam longitudinem contractis et deinde sensim longe attenuatis, subcoriaceis, ad costam inferne decidue pallide paleatis, alibi glabris; venis late patentibus, in pinnis maximis fere 2 mm inter se remotis, opacis; synangiis 1.5 ad 2 mm a margine remotis, 3 mm longis, circa 12-locularibus, indusio conspicuo lacerato; pinnulis parte superiore frondis circa 7.5 cm longis, partibus omnibus proportionalibus.

DUTCH NEW GUINEA, *Brass No. 12117*, 15 kilometers southwest of Bernhard Camp, Idenburg river, altitude 1,800 meters, "fronds usually 3.2 long."

This is a member of the large central group of the genus often confused with *M. fraxinea*, and is distinguished by the peculiar shape of the pinnules.

**MARATTIA CORONATA Copeland sp. nov.**

*M. tafaensi* affinis fronde tripinnata pinnulis secundariis distalibus maximis; rhachi primaria deorsum 15 mm crasso, fusco, postquam dejectis paleis tuberculis munita; pinnis 60 cm longis, infimis stipitulis 4 cm longis donatis, rhachibus purpurascentifuscis, paleis ferrugineis 1 ad 2 mm longis integris vel plerisque laceris sparsis sat persistentibus vestitis, linea mediana superne atropurpurascente; pinnulis[i] patentibus fere sessilibus, circa 15 cm longis, linearibus, apices versus dilatatis, rhachibus sparse paleaceis, inter pinnulas[ii] anguste alatis; pinnutis[ii] numeros-

[1] This paper includes the fourth report on the ferns collected by the Third Archbold Expedition to New Guinea. Previous reports were published in Phil. Jour. Sci. 73 (1940) 345–357; 457–469; 75 (1941) 347–361.

issimis, typice ovatis, hic uniforme 6 mm longis 5 mm latis, acutis, basi cuneatis, serratis dentibus 1 ad 3, obscure viridibus, subcoriaceis, glabris, terminalibus circa 3 cm longis lanceolatis acuminatis, subterminalibus etiam lanceolatis minus elongatis sterilibus; synangiis ad pinnulam quamque circa 3, magnis, loculis 8- ad 10-paribus, indusio primo conspicuo, lacero, ferrugineo, denique evanido. Plantarum aliarum pinnulis[ii] majoribus, ordinatim 10 mm vel 13 mm longis, ad vix iis typi latioribus, synangiis superficiem fere complentibus 3- ad 5-paribus.

DUTCH NEW GUINEA, *Brass No. 12116,* type, 15 kilometers southwest of Bernhard Camp, Idenburg river, altitude 1,800 meters, "Common in undergrowth in gullies. Leaves usually 3, about 2.5 m long, arched and spreading, from a fleshy subglobose stock about 20 cm in diam." *No. 12116A,* with the type, secondary pinnules a little larger, the primary pinnules near the tip of the pinna undivided, 7 cm long, caudate. *No. 11484,* Bele river, altitude 2,300 meters, secondary pinnules 10 to 12 mm long. *No. 10765,* near Lake Habbema, altitude 2,750 meters, secondary pinnules about 15 mm long, lanceolate; possibly distinct but not to be so judged by a single collection.

*No. 12902,* altitude 1,200 meters, may be *M. tafaensis* or may be a distinct species. Neither the specimen nor the notes shows whether it is bipinnate or tripinnate. The leaflets are about 15 mm long, broadly lanceolate acute, falcate, almost entire. The rachises are glabrescent. The terminal leaflets are enlarged; whether or not this is so of *M. tafaensis* is not known.

*M. coronata* is one of a group that may be typified by its first described species, *M. melanesica* Kuhn, from which it differs, *inter alia,* by persistent scaliness. *M. Werneri* is apparently distinguished by the presence of a single synangium borne on the costa of each fertile pinnule; the single known specimen is immature, the synangia still almost concealed by the dissected indusia. *M. coronata* differs from *M. tafaensis* by its persistent scaliness, and in that the latter, so far as known, is only bipinnate. We need information as to the variability of *Marattia,* and as to correlation among the supposed specific criteria.

**MARATTIA MEGAPTERA Copeland sp. nov.**

Stipite sicco collapso 1 cm crasso, castaneo, spinis 1 ad 1.5 mm altis validis sparsis armato, paleis 1 ad 6 mm longis obscuris vivo scilicet carnosis sparso; pinna 50 cm longa, stipitulo ejus 10 cm longo incluso, rhachi sicca rugosa haud alata, fusca,

minute nigro-verruculosa; pinnulis 4-paribus impari carente, breviter (4 mm) pedicellatis, 20 ad 25 cm longis, 5 ad 6 cm latis, basi subaequali-cuneatis, apice acutis et deinde (apicem extendiente) caudatis cauda 15 mm longa 1 ad 2 mm lata, margine infra caudam minute serrulato alibi integro, subcoriaceis, glabris sed costa squamulis minutis ferrugineis sparsa; venis haud densis, tenuissimis, opacis; soris permultis, 0.5 ad 2.5 mm a margine remotis, 2 ad 3 mm longis, usque ad 20 locularibus, indusiis brevibus (vetustate) integris inconspicuis.

DUTCH NEW GUINEA; *Brass No. 13668,* 2 kilometers southwest of Bernhard Camp, Idenburg river, altitude 750 meters. "One plant on slope in rain forest, leaves 2; stipe of larger leaf 1.43 m, lamina 0.65 m."

Evidently near *M. obesa* Christ, but apparently different in its caudate tips, entire margin, large synangia, and in other respects. The spinose stipe may seem very novel, but the stipes of many species are undescribed, and minor tubercles occur on the stipes of several.

**SCHIZAEA PAPUANA Brause.**

*Brass 9089,* altitude 3,225 meters; *Brass & Myer-Drees 10018, 10385,* altitude 3,560 and 3,700 meters, all in boggy grass. All are one species, though *No. 9089* has darker bristles on the rhizome and more numerous fertile pinnæ, the other two collections being dwarfed; the tallest frond of *No. 10018* does not reach 8 cm. All examples have exceedingly slender "fronds." I have not seen authentic *S. papuana,* described as an epiphyte in moss cushions in the crown of a tree,—not a typical place for any *Schizaea,*—and may err in the identification. *S. papuana* is reduced to *S. malaccana* in Index Suppl. III, 170, but the collections in hand are not that species. They might be regarded as dwarfed *S. fistulosa,* but seem distinct to me.

# NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XLIV

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FOUR PLATES

In the present article I am discussing crane flies from several localities in Asia, including the following countries and collectors: Manchukuo: Weymarn; Japan: Esaki, Issiki, Machida, and Suenson; China and Indo-China: Brownell, Cooman, Franck, Graham, Kellogg, Klapperich, Piel, Suenson, and Tsen; the Philippines: Rivera; and British India: Nathan and Sircar. I am greatly indebted to all of the above scientists and collectors for their interest in saving specimens of these flies. Except where indicated to the contrary in the text, the types of the novelties are preserved in my collection of these flies.

## TIPULINÆ

**TANYPTERA CHRYSOPHÆA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.**

General coloration brownish yellow to reddish yellow; antennæ and halteres yellow throughout; basal three flagellar segments elongate-cylindrical, outer segments short-oval; legs yellow, outer tarsal segments black; wings with basal two-thirds intense yellow, especially the costal portion, apex broadly brown; Rs exceeding twice length of m-cu; abdomen with cerci long and relatively narrow.

*Female.*—Length, about 24 millimeters; wing, 18; antenna, about 5.5.

Frontal prolongation of head brownish yellow, without nasus, setæ yellow; palpi with basal three segments brownish yellow, terminal segment black. Antennæ (Plate 2, fig. 25) yellow throughout; first flagellar segment elongate, subequal in length to scape; second segment about two-thirds as long as first; third segment about three-fourths as long as second; remaining segments conspicuously smaller, especially seventh to twelfth, inclusive, which are irregularly short-oval; terminal segment abruptly smaller. Head dull black; anterior vertex wide.

Pronotum obscure yellow. Mesonotal præscutum shiny obscure yellow or brownish yellow, with three more reddish stripes, median stripe with a capillary black median vitta on cephalic third of sclerite; a lateral brown spot on margin behind humeri; setæ or præscutal interspaces golden yellow; posterior sclerites of notum reddish yellow, parascutella darker. Pleura yellow, variegated with black on ventral anepisternum, ventral sternopleurite, pteropleurite, meron, and ventral pleurotergite. Halteres yellow throughout. Legs with coxæ and trochanters yellow; femora and tibiæ yellow, unmarked; tarsi passing through brownish yellow to black. Wings (Plate 1, fig. 1) with basal two-thirds intense yellow, distal third beyond cord medium brown; prearcular field, costal border, and a seam along vein Cu more saturated yellow; stigma yellow; basal third of cell 1st $M_2$ and adjoining part of cell $M_3$ of yellow ground color; outer ends of cells Cu and 1st A brown; veins yellow in saturated portions, remainder, including Rs, M, and anal veins brown. Venation: Rs relatively long, exceeding twice length of m-cu; $R_2$ relatively long and conspicuous, so $R_1$ and $R_{1+2}$ are in virtual longitudinal alignment; petiole of cell $M_1$ about one-half m; m-cu just before fork of $M_{3+4}$.

Abdomen uniformly reddish yellow; ovipositor with cerci long and relatively narrow, much narrower than in *antica* but wider than in typical members of the genus. Similarly, the preceding genital segments are shorter and less attenuated than in typical forms, as *atrata*.

*Habitat.*—China, Fukien.

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, April 15, 1936 (*Klapperich*); type returned to the Zoologisches Forschungsinstitut, Bonn, Germany.

*Tanyptera chrysophæa* is readily told from other regional species by the coloration, especially the pattern of the wings, and by the structure of the ovipositor.

**CTENACROSCELIS PERSESSILIS sp. nov. Plate 1, fig. 2.**

General coloration of mesonotum dark brown, præscutum with four slate-gray stripes; antennæ black, intermediate flagellar segments strongly produced on ventral face; posterior sclerites of mesonotum yellow; pleura pale brown with a golden-yellow longitudinal stripe; halteres and legs brownish black; wings with a strong brownish tinge; a strong element $R_{1+2+3}$ before fork of $R_{1+2}$ and $R_3$; cell $M_1$ broadly sessile; abdominal tergites

dark brownish gray, lateral borders of segments paling to buffy; genital shield of ovipositor chestnut-brown.

*Female.*—Length, about 30 millimeters; wing, 27.

Frontal prolongation of head elongate, subequal to or a little longer than remainder of head, dark brown, narrowly light gray-pruinose along dorsal surface; nasus conspicuous; palpi black. Antennæ black, scape pruinose; first flagellar segment long-cylindrical, exceeding scape in length; fifth to eighth flagellar segments, inclusive, with ventral face strongly produced; terminal three segments nearly cylindrical, last shortest, about one-half penultimate. Head gray-pruinose, with a brownish median vitta; vertical tubercle low.

Pronotum dark brown medially, paling to buffy yellow on sides. Mesonotal præscutum with ground color dark brown, virtually restricted to humeral portions of sclerite, remainder of disc with four slate-gray stripes, intermediate pair of stripes separated by a ground vitta except at suture where all four stripes become confluent; lateral portions of præscutum dark brown, extreme cephalic margins of anterior portion of sclerite buffy; scutal lobes slate-gray, median area behind suture with a very conspicuous dark-brown triangular area, remainder of scutum obscure yellow; scutellum obscure yellow, restrictedly darkened medially in front, parascutella dark; mediotergite yellow. Pleura pale brown, with a more golden-yellow longitudinal stripe from behind fore coxæ to base of abdomen, this stripe covered with delicate silken setulæ; ventral sternopleurite darker brown; dorsopleural membrane buffy. Halteres brownish black, base of stem restrictedly pale. Legs with coxæ dark brown, pruinose; trochanters black, sparsely pruinose; remainder of legs brownish black. Wings (Plate 1, fig. 2) with a strong brownish tinge, centers of cells M, 2d A, and outer medial cells more brownish yellow; veins brown. Venation: $Sc_1$ preserved as a strong spur; $R_1$ beyond free tip of $Sc_2$ strongly longitudinal in position, forming a relatively long fusion of $R_{1+2+3}$; $R_3$ only moderately sinuous, cell but little constricted at midlength, wide at margin; cell $M_1$ broadly sessile; cell 1st $M_2$ elongate, outer end narrowed; m-cu at fork of $M_{3+4}$.

Abdominal tergites dark brownish gray, lateral borders of segments paling to buffy; basal sternites dark gray, outer segments paling to reddish brown. Ovipositor with genital shield chestnut-brown, valves dark chestnut-brown.

*Habitat.*—China, Szechwan.

Holotype, female, Hai-tsi-pin, altitude 13,000 feet, July and August 1937 (*Graham*); United States National Museum.

*Ctenacroscelis persessilis* is quite distinct from all other species of the genus so far made known, differing conspicuously in the coloration and in the venation, as the broadly sessile cell $M_1$.

TIPULA (YAMATOTIPULA) KAMIKOCHIENSIS sp. nov. Plate 1, fig. 3; Plate 2, fig. 26.

Belongs to the *iroquois* group, allied to *machidai;* large (wing, male, 20 millimeters); antennæ relatively short, flagellum black; basal enlargements of segments only poorly developed; general coloration of notum gray, pronotum, scutum, and scutellum with a median brown vitta; femoral tips broadly blackened; tibiæ black, extreme bases pale; wings brownish yellow, restrictedly patterned with darker, including outer radial field; wing petiole long; abdominal tergites yellow, lateral borders gray, median area with a nearly continuous black stripe; hypopygium black; male hypopygium with apical portion of tergite flattened, yellow, caudal margin with a V-shaped notch; outer dististyle pale, truncated at apex; inner dististyle with apex of rostral prolongation broadly obtuse, outer margin of style with two blackened points, longest point an acute spine that is directed outward.

*Male.*—Length, about 16 millimeters; wing, 20; antenna, about 3.

Frontal prolongation of head dark brown, grayish pruinose, relatively short, about one-half remainder of head; nasus long and slender; palpi brownish black, moderately long terminal segment pale on basal half, infuscated on distal portion. Antennæ relatively short; scape brownish yellow, more darkened outwardly; pedicel brown; flagellum black; flagellar segments with basal enlargements only poorly developed, verticils longer than segments; terminal segment reduced, pointed at apex. Head gray, with a narrow, dark-brown, median vitta; vertical tubercle small.

Pronotal scutum gray, with a narrow, median, dark-brown vitta, scutellum pale yellow. Mesonotal præscutum light gray, with four conspicuous brown stripes, intermediate pair of stripes separated by a dark-gray central area, mesal edges of stripes vaguely indicated by capillary dusky lines; lateral stripes entire, without differentiated margins; humeral region restrictedly buffy, lateral præscutal border behind humeri dark; posterior sclerites of notum dark gray with a slightly darker median vitta extending from suture to about midlength of scutellum; post-

notum clearer gray. Pleura light gray on mesepisternum, anepisternum and ventral sternopleurite darker gray; meron gray, darker ventrally; pteropleurite and pleurotergite, with the dorsopleural membrane, more buffy yellow, pleurotergite more darkened immediately above the halteres. Halteres with stem brownish yellow, knob dark brown. Legs with coxæ light gray; trochanters obscure yellow; femora yellow, tips broadly blackened, on fore pair occupying nearly distal fourth, narrower on posterior femora where only about outer sixth is included; tibiæ black, bases narrowly obscure yellow; tarsi black; claws with strong lateral spine. Wings (Plate 1, fig. 3) brownish yellow, prearcular and costal fields somewhat clearer yellow; stigma oval, dark brown; wing tip, especially in outer radial field, weakly infuscated; Cu narrowly seamed with brown, much more conspicuous on the distal section and along m-cu; vein 2d A restrictedly seamed with darker; veins brownish black, paler in brightened portions. Wing base long and petiolate; squama naked. Venation: $M_{3+4}$ shorter than basal section of $M_{1+2}$; cell 2d A relatively wide.

Abdomen with basal tergite yellow basally and on sides, brownish pruinose behind; succeeding tergites yellow, lateral borders broadly gray, median portion with a conspicuous brownish-black stripe that is narrowly interrupted at caudal border of segment; sternites light yellow; outer segments and hypopygium uniformly blackened. Male hypopygium (Plate 2, fig. 26) with tergite, 9*t*, produced caudad into a very flattened, depressed, yellow blade, the caudal margin of which bears a V-shaped notch, median area beneath more or less carinate; ventral surface of pale apical portion on either side with a yellow flattened lobe; cephalic portion of tergite blackened and with abundant black setæ, forming a densely setiferous triangular block in the central portion, point of triangle directed caudad. Basistyle not or only weakly produced at apex, its outer surface with several long, yellow setæ. Outer dististyle, *od*, a pale flattened blade, apex truncated, outer margin strongly dilated or bellied outwardly. Inner dististyle, *id*, as shown, bearing a short, obtuse, blackened point that is directed backward, and a longer, black, acute spine directed outwardly; rostrum broadly obtuse, blackened. Gonapophyses only weakly obtuse at tips.

*Habitat.*—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, July 26, 1939 (*Suenson*).

This interesting fly is most nearly related to *Tipula* (*Yamatotipula*) *machidai* Alexander and *T.* (*Y.*) *sempiterna* Alexander among the described regional species, differing from both especially in the distinct structure of the male hypopygium. The antennæ are much shorter than in *machidai,* while body size and general coloration differ in all three species. I had earlier [1] referred the species of this group to the subgenus *Oreomyza* Pokorny. The recent discovery of several new species in the southern Appalachian Mountains of eastern North America now seems to indicate that the three Japanese species, as well as the five eastern Nearctic members of the *iroquois* group, are better referred to the subgenus *Yamatotipula* Matsumura.

**TIPULA (YAMATOTIPULA) SUENSONI Alexander.**

*Tipula suensoni* ALEXANDER, Encycl. Ent. Diptera 2 (1925) 89–91, figs. 4, 5.

Kuliang, Fukien Province, eastern China, 1,500 to 2,500 feet, April 6 to 13, 1938; 1,800 to 2,000 feet, July 1 to 7, 1938 (*Kellogg*).

**TIPULA (ACUTIPULA) RECEPTOR sp. nov. Plate 1, fig. 4; Plate 2, figs. 27 and 28.**

Allied to *quadrinotata;* general coloration of notum brownish gray, præscutum with four narrow, darker brownish-gray stripes; scutellum and postnotum clearer gray, pleura yellow; femora yellow, tips narrowly but conspicuously infuscated; wings with a weak brown pattern, sparsely variegated with cream-colored areas; a small brown cloud before midlength of cell Cu; Rs subequal in length to m-cu; male hypopygium with median lobe of tergite large, divided into two flaplike blades set with numerous black spinules; eighth sternite unprovided with brushes of setæ.

*Male.*—Length, about 15 to 16 millimeters; wing, 16 to 17; antenna, about 3 to 3.1.

Frontal prolongation of head brown; nasus elongate; palpi brown. Antennæ of moderate length; basal three or four segments obscure yellow, succeeding segments weakly bicolored, darker basally than at tips, outer segments more uniformly infuscated; basal swellings of segments only poorly indicated; verticils relatively short. Head brownish gray with a narrow, dark-brown, median line; anterior vertex about two and one-half times diameter of scape.

[1] Phil. Jour. Sci. 57 (1935) 122.

Pronotum obscure brownish yellow, with a distinct median impression. Mesonotal præscutum brownish gray with four narrow, darker brownish-gray stripes that are vaguely bordered by darker; scutum brownish gray; scutellum and postnotum clearer gray, the former not darker behind but with vague indications of a darker median vitta. Pleura yellow, dorsal pleurotergite dark. Halteres elongate, dark brown. Legs with coxæ and trochanters yellow; femora yellow, tips narrowly but conspicuously infuscated, the amount subequal on all legs; tibiæ brownish yellow, tips weakly darkened; tarsi elongate, light brown, terminal segments passing into black. Wings (Plate 1, fig. 4) with a weak brown pattern, variegated with cream-colored areas, the latter most evident as a broad obliterative streak at cord and across bases of cells $M_1$ to $M_4$, inclusive; cell Cu whitened basad of the darkened area before midlength, the latter relatively small; cells C and Sc, with stigma, slightly darker than ground; a slight darkened wash near outer end of cell M; veins brown, pale in obliterative streak. Wing of paratype slightly wider than that of type. Venation: Rs subequal to or a trifle longer than m-cu, the latter a short distance before fork of $M_{3+4}$.

Abdominal tergites obscure yellow, with indications of a slightly darker median stripe, more distinct on outer segments; lateral tergal borders continuously darkened; sternites obscure yellow, outer three segments uniformly dark brown. Male hypopygium with median lobe of tergite (Plate 2, fig. 27, 9*t*) conspicuous, appearing as two flattened blades separated by a conspicuous U-shaped notch, lobes set with abundant, very short, blackened pegs. Apex of basistyle (Plate 2, fig. 28, *b*) produced into a short lobe bearing a brush of long yellow setæ that much exceed the lobe in length. Outer dististyle, *od,* pale, narrowly obtuse at apex, widely dilated across basal third, width at this point about two-thirds length. Inner dististyle (Plate 2, fig. 28, *id*) complex, as illustrated, consisting of a long outer spine, acute apical point distinctly darkened and set off by a weak constriction; between this spine and beak a smaller, straight spine; beak relatively small, flattened; setæ on face of style very long but slender. Ninth sternite with the usual dense brushes of setæ on either side of midline. Eighth sternite almost glabrous, posterior margin with only scattered setæ, quite without hair brushes or pencils as found in related Oriental species.

*Habitat.*—Assam, Khasi Hills.

Holotype, male, Cherrapunji, altitude 4,000 feet, 1935 (*Sircar*).

Paratopotype, male.

The closest regional ally of the present fly is evidently *Tipula (Acutipula) quadrinotata* Brunetti, which differs in details of coloration of body, legs, and wings, but especially in the structure of the male hypopygium, notably the tergite, outer dististyle, inner dististyle, and the eighth sternite, the last structure having conspicuous hair brushes that are lacking in the present fly.

**TIPULA (SCHUMMELIA) CRASTINA sp. nov. Plate 1, fig. 5; Plate 2, fig. 29.**

Belongs to the *variicornis* group; general coloration brown, præscutum brownish yellow with three darker-brown stripes, central stripe much paler in front and divided by a capillary dark-brown vitta; posterior sclerites of notum brown; antennæ bicolored, segments yellow with dark-brown bases; legs black, femoral bases obscure yellow, narrowest on fore pair; wings with a brownish tinge, sparsely patterned with darker brown; large cream-colored areas before and beyond large dark-brown stigma; cell 1st $M_2$ small, its proximal end lying far basad of other elements of anterior cord; male hypopygium with tergite produced medially into a broad, more or less depressed lobe; eighth sternite moderately sheathing, without lobes.

*Male.*—Length, about 9 to 9.5 millimeters; wing, 10 to 10.5; antenna, about 3.5 to 3.6.

Frontal prolongation of head brown; nasus stout; palpi dark brown. Antennæ (male) of moderate length; basal three segments yellow, all remaining segments bicolored, basal enlargement dark brown, the more extensive apical portions yellow; basal enlargements only feebly developed; longest verticils a trifle shorter than segments. Head grayish brown to dark brown, anterior vertex a little brightened; a more or less evident capillary, median, dark vitta.

Pronotum brown. Mesonotal præscutum with ground color brownish yellow, with three darker-brown stripes, central stripe divided by a capillary, darker brown, median vitta; cephalic two-thirds of median stripe much paler, not or scarcely differentiated from the ground; lateral stripes entire; lateral and humeral portions of præscutum slightly darkened; scutum with median area obscure yellow, lobes chiefly darkened; scutellum

and mediotergite brown, sparsely pruinose. Pleura almost uniformly dark brown; dorsopleural region dusky. Halteres with stem and apex of knob obscure yellow, base of knob dark brown. Legs with coxæ brownish testaceous; trochanters yellow; remainder of legs black, femoral bases yellow, narrowest on forelegs, more extensive on posterior pair, involving basal third to half; claws small, simple. Wings (Plate 1, fig. 5) with a brownish tinge, prearcular and costal regions more brownish yellow; stigma large, oval, dark brown; narrow but conspicuous brown seams along cord and vein Cu; much narrower seams on outer radial veins, Rs and 2d A; wing apex and posterior border narrowly seamed with darker; conspicuous cream-colored areas before and beyond stigma; obliterative areas crossing cell 1st $M_2$; veins brown, paler in costal and prearcular fields. Venation: Rs relatively long, arcuated, exceeding m-cu; $R_2$ oblique, in approximate longitudinal alignment with $R_{1+2}$; cell 1st $M_2$ small, its inner end lying far proximad of other elements of anterior cord; m-cu before midlength of $M_{3+4}$, in the type specimen only a short distance beyond fork of M.

Abdominal tergites obscure yellow, posterior and lateral borders darkened; a more or less distinct brown, median vitta; outer segments, including the small hypopygium, brownish black; sternites obscure yellow. Male hypopygium (Plate 2, fig. 29) with ninth tergite, 9*t*, produced medially into a broad, more or less depressed lobe, the sides of which are densely hairy; lateral tergal lobes broad, truncated and feebly emarginate at apices. Outer dististyle, *od*, relatively broad and flattened, pale throughout. Inner dististyle, *id*, simple, oval in outline, with abundant black retrorse setæ over the surface; beak slender, blackened. Eighth sternite, 8*s*, moderately large and sheathing, margin unarmed with lobes or modified groups of setæ.

*Habitat.*—China, Fukien.

Holotype, male, Kuliang, altitude 1,800 to 2,000 feet, June 1 to 3, 1937 (*Kellogg*). Paratopotype, male, altitude 2,000 feet, May 22 to 27, 1937.

*Tipula* (*Schummelia*) *crastina* is entirely distinct from other small regional species of the subgenus. It is most similar to species such as *T.* (*S.*) *insulicola* Alexander, yet entirely distinct.

**TIPULA (OREOMYZA) LACUNOSA sp. nov. Plate 1, fig. 6; Plate 3, fig. 30.**

Allied to *quadrifasciata;* general coloration gray, præscutum with four darker brownish-gray to brown stripes; præscutal

interspaces with conspicuous setigerous punctures; antennæ with basal three segments yellow, remainder of flagellum almost uniformly black; halteres obscure yellow, base of knob weakly darkened; legs black, femoral bases yellow, narrowest on forelegs; wings whitish subhyaline, with four more or less complete dark crossbands; $R_{1+2}$ chiefly atrophied; male hypopygium with outer dististyle very expanded; inner dististyle with a long glabrous rod on outer margin at base; outer margin of beak without conspicuous modified setæ; gonapophyses consisting of strong blackened spines.

*Male.*—Length, about 10 millimeters; wing, 11.5; antenna, about 3.5.

*Female.*—Length, about 12 to 13 millimeters; wing, 11.5 to 12.

Frontal prolongation of head gray-pruinose above, darker laterally; nasus distinct; palpi black. Antennæ relatively short; basal three segments light yellow, succeeding two segments black with extreme tips paling to reddish, outer segments uniform black; basal swellings of segments not or scarcely differentiated; verticils a little shorter than segments; terminal segment reduced. Head brownish gray, front and orbits clearer gray; a scarcely evident darker median vitta.

Pronotum brownish gray. Mesonotal præscutum light gray with four darker brownish-gray to brown stripes; punctures of interspaces brown, large, conspicuous; scutum gray, each lobe with disconnected brown areas, space between latter with several setigerous punctures; scutellum gray, narrowly darkened medially; postnotum light gray, mediotergite with indications of a capillary dark vitta. Pleura gray, dorsopleural membrane pale yellow. Halteres obscure yellow, base of knob weakly darkened. Legs with coxæ gray; trochanters brownish yellow; femora obscure yellow basally, tips broadly black, most extensive on fore pair where distal three-fourths or more is blackened, on posterior legs including about outer half or less; tibiæ and tarsi black; claws (male) with basal tooth. Wings (Plate 1, fig. 6) whitish subhyaline, with four more or less complete dark crossbands, first crossband postarcular, second at level of origin of Rs, much widened but paler in posterior portion; third band at cord, fourth band apical, darker in radial field; cell C dark brown, Sc more brownish yellow; stigma dark brown; broad, entire white band beyond cord narrowest at cephalic border in basal portion of cell $Sc_2$ and at posterior end in cell $M_3$, very wide in radial field; outer medial veins very narrowly seamed

with brown though scarcely interrupting white band; anterior prearcular field dark, posterior portion whitish, including veins; veins dark brown, pale yellow in ground areas. Venation: Rs very long, approximately three times m-cu or nearly so; tip of $R_{1+2}$ atrophied.

Abdominal tergites reddish brown, sparsely pruinose, with a darker-brown median stripe that becomes widened behind, posterior borders of segments pale, sparsely pruinose; no distinct darkened lateral stripes; sternites reddish brown, outer segments more pruinose. Male hypopygium (Plate 3, fig. 30) with ninth tergite, *9t*, broadly emarginate, with a tiny median notch from which a dorsal furrow extends cephalad the length of the sclerite; lateral lobes yellow, short, obtuse. Outer dististyle, *od*, a very broadly expanded pale blade. Inner dististyle, *id*, with a long glabrous rod on outer face at base, with a setiferous flange just distad of it; beak of style blackened, relatively narrow; no series of strong marginal setæ as in *quadrifasciata*. Gonapophyses conspicuously spinous, as shown. Eighth sternite with numerous long, pale setæ on median portion of caudal margin, with an additional brush in membrane between eighth and ninth sternites.

*Habitat.*—China, Fukien.

Holotype, male, Kuliang, altitude 1,500 to 2,500 feet, April 6 to 13, 1938 (*Kellogg*). Allotopotype, female, April 10, 1938. Paratopotype, 1 female, altitude 2,000 feet, April 20, 1938.

Most closely related to the Japanese *Tipula* (*Oreomyza*) *quadrifasciata* Matsumura, differing especially in the structure of the male hypopygium, especially the dististyles and gonapophyses.

TIPULA (OREOMYZA) SUBDEPRESSA sp. nov. Plate 1, fig. 7; Plate 3, figs. 31 to 33.

Allied to *depressa;* mesonotal præscutum gray with four narrow but conspicuous dark-brown stripes; fore femora black with only the bases narrowly brightened, remaining femora obscure yellow, tips rather narrowly blackened; wings brown, variegated by more cream-colored areas before cord and beyond stigma; male hypopygium with lateral tergal arms acute, with a narrow blackened inner lobe; inner dististyle with basal outer lobe separated from main body of style by a circular notch; eighth sternite with median pale lobe about two and one-half times as long as wide.

*Male.*—Length, about 14 millimeters; wing, 16; antenna, about 4.1.

Frontal prolongation of head black, heavily pruinose; nasus distinct; palpi black. Antennæ of moderate length; scape reddish brown, darker above and at base; pedicel yellow; flagellum uniformly black; flagellar segments moderately incised, the longest verticils a trifle shorter than segments. Head brownish gray, lighter in front, more suffused with darker behind; a capillary, dark-brown, median vitta extending from low vertical tubercle backward, becoming obsolete at near midlength of posterior vertex.

Pronotum brownish gray. Mesonotal præscutum gray, with four narrow but conspicuous dark-brown stripes, intermediate pair of stripes forming the broad borders of a darker-gray, median area, narrowed behind; the gray central portion nearly twice as wide as the dark stripes at cephalic portion of sclerite; lateral stripes narrow; posterior sclerites of mesonotum gray, each scutal lobe with two dark-brown areas; central portion of scutellum more darkened; mediotergite with a capillary dusky line. Pleura dark gray, with a more or less distinct lighter-gray area across ventral anepisternum, pteropleurite, and pleurotergite; dorsopleural membrane buffy. Halteres with stem yellow, knob dark brown. Legs with forecoxæ gray, remaining coxæ gray basally, paling to buffy at tips, buffy color unusually broad on posterior pair; trochanters yellow; fore femora black, only basal fifth or sixth brightened; middle and hind femora obscure yellow, brighter at base, tips (distal sixth or seventh) blackened; tibiæ dark brown, tips very narrowly black, fore tibiæ more uniformly brownish black; tarsi black; claws simple, hairy. Wings (Plate 1, fig. 7) with a strong brown tinge, prearcular field and cell Sc yellowish; cell C more brownish yellow; stigma brown; a conspicuous cream-colored poststigmal area in subbasal portions of outer radial field, with similar areas before cord in cells $R_1$, R, and M; a restricted obliterative streak crossing cell 1st $M_2$ into base of cell $M_3$; a pale marginal streak in cell 1st A near tip of vein 2d A; brown ground color deepening to a conspicuous seam along veins Cu and $Cu_1$; veins brown, yellow or brownish yellow in brightened costal portions. Squama naked. Venation: $R_{1+2}$ entire; Rs about twice m-cu; basal section of $M_{1+2}$ shorter than $M_{3+4}$.

Abdominal tergites yellow, conspicuously trivittate with brownish black, lateral stripes paler on extreme margins of sclerite; sternites yellow; terminal segments more uniformly blackened, central portion of tergite and distal portions of ninth

sternite obscure yellow. Male hypopygium with caudal margin of tergite (Plate 3, fig. 31, 9*t*) conspicuously toothed and blackened, including a strong, acute, median tooth that is flattened and has a carinate dorsal ridge; lateral angles of caudal border produced into acute points, with a longer, entirely blackened inner lobe that is irregularly lobed at apex. Outer dististyle (Plate 3, fig. 32, *od*) strongly flattened, constricted at base. Inner dististyle, *id,* with a strong lobe on outer margin at base, separated from main body of style by a circular notch; rostrum of style long and narrow, blackened. Gonapophyses (Plate 3, fig. 33, *g*) with outer lobe flattened, broader than acute spine at base. Eighth sternite (Plate 3, fig. 33, 8*s*) with a conspicuous, pale, depressed, median lobe, as in *depressa,* this lobe about two and one-half times as long as wide, subtended on either side by obtuse shoulders.

*Habitat.*—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, July 26, 1939 (*Suenson*).

The nearest ally of the present fly is *Tipula* (*Oreomyza*) *depressa* Alexander, likewise from the Japanese Alps, which differs especially in the details of structure of the male hypopygium, as follows: Lateral tergal arms broad, apices entire and truncated; outer dististyle narrower on outer portion; inner dististyle with basal lobe very large and flattened, only a little less extensive than remainder of style, separated from main body of latter by a broadly oval notch; gonapophyses with posterior lobe narrow, at central portion narrower than blackened spines; lobe of eighth sternite shorter and more broadly obtuse at apex, length less than twice greatest width.

**NEPHROTOMA ALTICRISTA sp. nov. Plate 1, fig. 8; Plate 3, fig. 34.**

General coloration yellow, præscutum with three polished leaden stripes that are very narrowly bordered by brownish black, cephalic end of median stripe paling to reddish; scutellum and postnotum uniformly yellow; antennæ with flagellar segments rather strongly incised; wings subhyaline, stigma medium brown, extreme wing tip vaguely darkened; abdomen with tergites yellow, trivittate with black; terminal three segments black; male hypopygium relatively small; inner dististyle with dorsal crest very high and glabrous.

*Male.*—Length, about 13 to 14 millimeters; wing, 11 to 12; antenna, about 4.8 to 5.

Frontal prolongation of head yellow, outer end of dorsal surface, together with the elongate nasus, darkened; palpi pale brownish yellow. Antennæ relatively long; basal three segments yellow; fourth segment pale brown, base a little darker; succeeding segments black; flagellar segments rather strongly incised, subequal in length to longest verticils. Head orange, vertex with a delicate brown median line extending from summit of vertical tubercle to occiput; occipital brand concolorous with remainder of head.

Pronotum orange. Mesonotal præscutum orange yellow, with three polished lead-colored stripes that are very narrowly bordered by brownish black; cephalic third of median stripe paling to reddish; an opaque brownish-black spot laterad of anterior end of outer præscutal stripe; scutum yellow, lobes extensively lead-colored, narrowly bordered by brownish black; scutellum and postnotum uniformly orange yellow. Pleura yellow, scarcely variegated by areas of more orange yellow. Halteres with stem pale brown or brownish yellow, base of knob infuscated, apex paling to obscure yellow. Legs with coxæ and trochanters yellow; femora obscure yellow, tips very narrowly, vaguely darkened; tibiæ obscure yellow; tarsi passing into black. Wings (Plate 1, fig. 8) subhyaline; stigma medium brown; extreme wing tip vaguely darkened; outer wing veins insensibly seamed with brown; veins dark brown. Stigmal trichia about 30 to 35. Venation: Rs a little longer than basal section of $R_5$; cell $M_1$ variable, from short-petiolate to very narrowly to broadly sessile; m-cu at fork of M or on $M_4$ shortly beyond origin.

Abdominal tergites yellow, conspicuously trivittate with black; seventh and succeeding segments black, outer appendages pale brown to yellowish brown. Male hypopygium (Plate 3, fig. 34) with tergite, 9*t*, transverse, caudal margin with two submedian rounded lobes that are set with blackened points and separated by a narrow U-shaped notch; outer lobes appearing as pale ears, their cephalic mesal portions with small black spines. Outer dististyle, *od*, with apical fourth narrowed. Inner dististyle, *id*, with beak slender; dorsal crest very high and glabrous. Gonapophyses, *g*, appearing as small pale blades, about twice as long as width at base, tips obtuse. Ædeagus profoundly trifid at apex. Ninth sternite with a small, finger-like, median lobe. Eighth sternite, 8*s*, extensive, sheathing, caudal margin not or scarcely notched, median area pale and membranous, its outline indicated in the figure by dots.

*Habitat.*—China, Szechwan.

Holotype, male, Mount Omei, Shuang Fei Chiao, altitude 3,000 feet, June 14, 1935 (*Graham*). Paratopotypes, 4♂ males, June 14 to 22, 1935. Type in the United States National Museum.

Allied to *Nephrotoma decrepita* Alexander and *N. pilata* Alexander, differing in the coloration of the body and, especially, in the structure of the male hypopygium. In the present fly the uniformly yellow scutellum and postnotum suffice to distinguish the species from the above-mentioned allies.

**NEPHROTOMA CIRCUMCINCTA sp. nov. Plate 1, fig. 9.**

General coloration yellow, præscutum with four nacreous stripes that are narrowly but completely encircled by velvety black; scutal lobes similarly nacreous, the areas encircled by black; scutellum and postnotum yellow; pleura yellow, weakly variegated by brown areas; wings subhyaline, cell Sc and stigma more darkened; no stigmal trichia; cell $M_1$ broadly sessile; abdominal tergites yellow, with a very broad, continuous, median, brown stripe, lateral tergal borders and pleural region similarly darkened; sternites yellow.

*Female.*—Length, about 13 millimeters; wing, 12.5.

Frontal prolongation of head yellow; nasus distinct, scarcely darkened but provided with long black setæ; palpi dark brown, intermediate segments more brownish yellow, terminal segment brownish black. Antennæ with basal three segments yellow, the organ broken beyond this point. Head deep orange, central portion of vertex weakly more infuscated; vertical tubercle low; occipital brand very small, reduced to an equilateral triangle on the occiput itself.

Pronotum conspicuously dark brown on anterior half of scutum and along the lateral margins, broad posterior portion of scutum, entire scutellum, and pretergites yellow. Mesonotal præscutum yellow with four nacreous stripes that are narrowly but completely encircled by velvety black, the two inner margins of the intermediate stripes thus forming a continuous median stripe of twice the width; opposite the anterior ends of the lateral stripes the velvety black area is widely expanded toward the margin, almost reaching it, but the stripe itself is not deflected laterad; suture darkened; scutum with the median area broadly yellow, each lobe occupied by two confluent nacreous areas that are encircled by a common velvety-black ring; scutellum and parascutella testaceous yellow; postnotum

yellow, posterior border vaguely more grayish, this portion on lateral angles provided with microscopic setulæ. Pleura and pleurotergite almost uniformly yellow, anepisternum and ventral sternopleurite, with the meron, weakly darkened. Halteres brownish yellow, knob slightly more darkened. Legs with coxæ and trochanters yellow; femora yellow, extreme tips vaguely more darkened; tibiæ and proximal portion of basitarsi obscure yellow, remainder of tarsi passing into brown. Wings (Plate 1, fig. 9) subhyaline, cell Sc and stigma darker; veins brown. No stigmal setæ except on veins. Venation: $Sc_1$ weakly preserved; cell $M_1$ broadly sessile; m-cu joining $M_4$ just beyond its origin.

Abdominal tergites yellow, with a very broad, continuous, median, brown stripe, lateral borders and pleural region similarly darkened, leaving clear areas of the yellow ground on either side of the midstripe; subterminal segments more uniformly blackened; sternites more uniformly yellow. Ovipositor horn yellow; cerci straight, relatively stout, their ventral margins at base with microscopic setulæ.

*Habitat.*—Assam, Khasi Hills.

Holotype, female, Cherrapunji, altitude 4,000 feet, 1935 (*Sircar*).

The peculiar coloration of the thoracic notum will readily distinguish the present species from regional allies. In the Oriental fauna it is most like *Nephrotoma whiteheadi* Edwards and a few allied forms in the Malayan region. It is assumed that the nacreous præscutal stripes are normal, but since the unique type specimen is slightly teneral, these areas may change slightly in more fully colored individuals.

**DOLICHOPEZA (OROPEZA) SAUTERI (Riedel).**

*Oropeza sauteri* RIEDEL, Arch. für Naturgesch. pt. A 82 (1917) 114, 115.

Kuliang, Fukien Province, eastern China, 1,500 to 2,500 feet, April 10, 1938; 1,800 to 2,000 feet, May 11 to 30, July 1 to 7, 1937 (*Kellogg*). Hitherto known from Formosa.

## CYLINDROTOMINÆ

**CYLINDROTOMA ANGUSTIPENNIS sp. nov. Plate 1, fig. 10.**

General coloration pale yellow, head and thorax conspicuously patterned with black, including three nearly confluent præscutal stripes; knobs of halteres blackened; legs black, femoral bases restrictedly pale; wings narrow with a weak dusky tinge, the narrow stigma brownish black; Sc relatively short, $Sc_2$ ending

opposite fork of Rs; Rs long, nearly straight; abdomen, including ovipositor, black.

*Female.*—Length, about 11 millimeters; wing, 9.5.

Rostrum yellow, weakly darkened above; palpi black. Antennæ black, proximal end of scape paler; flagellar segments subcylindrical, outer segments slenderer. Head light yellow, posterior vertex and occiput black, sending a narrow arm laterad and beneath onto genæ, posterior orbits remaining broadly pale.

Pronotum with scutum black, scutellum yellow. Mesonotal præscutum very pale yellow or whitish yellow, conspicuously patterned with three black stripes that are virtually confluent in front, leaving narrow, pale interspaces behind; scutum pale yellow, each lobe with a conspicuous black area on mesal portion; scutellum pale yellow; mediotergite pale yellow, posterior third brownish black. Pleura pale yellow, conspicuously variegated with black on the ventral sternopleurite, ventral anepisternum, and extreme ventral edge of pleurotergite. Halteres with stem brownish yellow, knob blackened. Legs with coxæ yellow, fore pair of coxæ weakly infuscated on basal half; trochanters yellow; remainder of legs black, with about basal third of femora obscure yellow. Wings (Plate 1, fig. 10) with a weak dusky tinge, the narrow stigma brownish black; veins beyond level of outer end of cell 1st $M_2$ very narrowly bordered with dusky, so the veins appear unusually stout; veins brownish black. Wings narrow compared with *distinctissima* or *japonica*. Venation: Rs long, nearly straight, not or scarcely arcuated at origin, nearly twice length of $R_{2+3}$; $Sc_2$ ending opposite fork of Rs; cell $M_1$ short-petiolate; m-cu at near one-third length of cell 1st $M_2$.

Abdomen black, lateral margins of basal tergite pale; pleural membrane yellow; ovipositor with valves intensely black.

*Habitat.*—China, Szechwan.

Holotype, female, Mount Omei, Yien Lao Dong Temple, altitude 6,500 feet, August 5, 1935 (*Graham*); United States National Museum.

In its general coloration the present species is most similar to *Cylindrotoma distinctissima* (Meigen) of the western Palæarctic Region, or *C. japonica* Alexander of the eastern Palæarctic Region, differing in the narrow wings, with blackened veins, and in the blackened legs. *C. nigripes* Alexander has the general coloration black-pruinose, with the yellow areas very restricted; wings with Rs arcuated at origin and with Sc long,

$Sc_2$ ending some distance beyond the level of r-m. As previously indicated, I am now doubtful that the antennæ associated with the type specimen of *nigripes* really belong to this fly. In the type the antennæ were detached and the association cannot be finally confirmed or refuted.

## LIMONIINÆ

### LIMONIINI

**LIMONIA (DICRANOMYIA) POLI sp. nov. Plate 1, fig. 11; Plate 3, fig. 35.**

*Limonia (Dicranomyia) fullowayi* ALEXANDER, Phil. Jour. Sci. 63 (1937) 373; *nec fullowayi* ALEXANDER, Can. Ent. 47 (1915) 79, 80.
*Limonia (Dicranomyia) fullowayi* ALEXANDER, Notes d'Ent. Chinoise (5) 4 (1937) 70.

*Male.*—Length, about 4.5 to 5.5 millimeters; wing, 5 to 6.

Rostrum black, gray-pruinose; palpi black. Antennæ black throughout; flagellar segments oval. Head dark gray.

Mesonotum chiefly dark gray, præscutum with a conspicuous brown median stripe; scutal lobes with their centers similarly darkened. Pleura dark gray. Halteres pale, knobs weakly infumed. Legs with coxæ dark basally, paling at outer ends; trochanters yellow; femora obscure yellow, tips weakly darkened; tibiæ and tarsi pale brown, outer tarsal segments a little darker. Wings (Plate 1, fig. 11) subhyaline, with a restricted spotted gray or brownish-gray pattern, including a more or less abundant series of small dots in cell C and the usual two spots in cell 1st A adjoining vein 2d A. Venation: Cell 1st $M_2$ subequal in length to longest vein beyond it; m-cu close to fork of M.

Abdominal tergites brownish black, basal and intermediate sternites pale brown or yellowish brown; hypopygium black. Male hypopygium (Plate 3, fig. 35) with tergite, 9*t*, rather deeply and narrowly notched medially. Ventral dististyle, *vd*, about one and one-half the total area of basistyle, *b;* rostral prolongation unusually long and slender, nearly straight; a single rostral spine, long and straight, placed about its own length from apex of prolongation. Gonapophyses, *g*, with mesal-apical lobe bidentate at apex.

*Habitat.*—Japan and China.

Holotype, male, Mount Omei, Szechwan, China, altitude 4,000 feet, July 14, 1931 (*Franck*). Paratypes, numerous specimens, Kuling, northern Kiangsi, China, altitude 3,250 feet, July 31 to August 18, 1935 (*Piel*), in Musée Heude, Shanghai; Hong San, southeastern Kiangsi, altitude 2,500 feet, July 15, 1936

(*Gressitt*); Mount Hakone, Honshiu, Japan, altitude 2,300 feet, July 12, 1923 (*Esaki*); Shibuya, near Komaba, Tokyo, Japan, June 7, 1920 (*Machida*); Mount Kirishima, Kiushiu, Japan, altitude 2,500 feet, May 3, 1929 (*Issiki*).

An unfortunate confusion of names concerning one of the commonest and most wide-spread crane flies in eastern Asia has resulted from insufficient knowledge concerning the identity of *Limonia* (*Dicranomyia*) *fullowayi* (Alexander). Recent accessions of material from the Caroline and other Pacific islands has shown that the fly identified as *fullowayi* as it occurs in Japan and China is not this species but an undescribed form most nearly allied to *L.* (*D.*) *punctulata* (de Meijere) of the Greater Sunda Islands, yet amply distinct. This latter fly has the spine of the rostrum of the male hypopygium strongly curved at tip and the armature of the gonapophyses quite distinct.

LIMONIA (DICRANOMYIA) RETROGRADA sp. nov. Plate 1, fig. 12; Plate 3, fig. 36.

General coloration brownish gray, præscutum with a conspicuous, brownish-black, median stripe; antennæ black throughout; halteres with knobs black; wings yellowish, oval stigma dark brown; $Sc_1$ terminating opposite origin of Rs, $Sc_1$ long; male hypopygium relatively large and complex in structure; tergite narrowly transverse, with a median tubercle bearing about six long setæ; basistyle with ventromesal lobe large, boat-shaped; ventral dististyle small, white, its rostral prolongation abruptly blackened, long and slender, gradually narrowed outwardly; rostral spines two, placed on basal third of prolongation; ædeagus narrow.

*Male.*—Length, about 7.5 millimeters; wing, 8.

Rostrum and palpi dark brown. Antennæ black throughout; flagellar segments oval. Head brownish gray; anterior vertex relatively wide.

Pronotum brown above, paler laterally. Mesonotal præscutum brownish gray, with a conspicuous, brownish-black, median stripe, the lateral stripes scarcely indicated; posterior sclerites of notum brownish gray. Pleura heavily gray-pruinose. Halteres with stem obscure yellow, knob black. Legs with coxæ yellow, fore pair of coxæ weakly darkened basally; trochanters yellow; femora brownish yellow, clearer basally, tips narrowly brownish black; tibiæ and basitarsi brown, tips narrowly blackened; remainder of tarsi black. Wings (Plate 1, fig. 12) with a yellowish tinge, the oval stigma dark brown, conspicuous; veins

dark brown. Venation: $Sc_1$ ending opposite origin of Rs, $Sc_2$ far from its tip; free tip of $Sc_2$ and $R_2$ in approximate transverse alignment; m-cu at fork of M.

Abdominal tergites blackened, paler laterally, caudal borders more narrowly pale; basal sternites yellow, outer segments darker; hypopygium black, outer lobe of ventral dististyle conspicuously white. Male hypopygium (Plate 3, fig. 36) with tergite, 9*t*, very narrowly transverse, caudal margin gently emarginate, lateral lobes thus very low but indicated by thickenings provided with setæ; a smaller median tubercle bearing six or seven very long setæ. Basistyle, *b*, entirely black, very small, its outer face with unusually few setæ; ventromesal lobe very large and conspicuous, boat-shaped. Dorsal dististyle a gently curved blackened rod, tip acute. Ventral dististyle, *vd*, small, its area much less than that of the total basistyle; outer whitened lobe oval; rostral prolongation and its basal enlargement abruptly black; prolongation a slender blade that very gradually narrows outwardly, tip acute, along margin with five or six equally spaced setæ; rostral spines broken in the unique type, only their bases remaining, place close together on the basal third of the prolongation, directed outwardly; basal enlargement of prolongation with conspicuous pencils and brushes of elongate setæ. Gonapophyses, *g*, with mesal-apical lobe gently curved at tip. Ædeagus, *a*, unusually slender, constricted at and before midlength, distal end very weakly expanded, terminating in two parallel lobes that are separated by a linear slit.

*Habitat.*—China, Szechwan.

Holotype, male, Tatsienlu, October 31, 1938 (*Franck*); caught on table, all its movements being either backward or to one side, not forward.

*Limonia* (*Dicranomyia*) *retrograda* is still another of the now numerous Asiatic species of the subgenus having a complex male hypopygium. It differs from all other generally similar regional species, as *L.* (*D.*) *gracilirostris* Alexander, *L.* (*D.*) *grahamiana* Alexander, *L.* (*D.*) *tseni* Alexander, and *L.* (*D.*) *veternosa* Alexander, in the structure of the male hypopygium. The most similar of these species, based on the structure of the hypopygium, is *gracilirostris*, which has this organ quite distinct in every detail. The habit of walking of the adult fly, as described by Franck, is relatively common among members of the various subgenera of *Limonia*.

**LIMONIA (LIMONIA) NEONEBULOSA Alexander.**

*Dicranomyia nebulosa* ALEXANDER, Can. Ent. 45 (1913) 203–205, preoccupied.

*Limonia neonebulosa* ALEXANDER, Phil. Jour. Sci. 24 (1924) 555, 556.

China, Chekiang: Hills south of Ningpo, halfway to Nimrod Sound, May 1 to 4, 1925 (*Suenson*); Szechwan, Mount Omei, altitude 4,000 feet, August 13, 1931 (*Franck*). Wide-spread in Japan and China.

**HELIUS (HELIUS) NIPPONENSIS (Alexander).**

*Rhamphidia nipponensis* ALEXANDER, Can. Ent. 46 (1914) 207–209.

China, Chekiang: Hills south of Ningpo, halfway to Nimrod Sound, May 1, 1925 (*Suenson*). One male, Hang-chow, April 28, 1924 (*Suenson*). Hitherto known from Japan.

**HELIUS (HELIUS) PLUTO Alexander.**

*Helius* (*Helius*) *pluto* ALEXANDER, Phil. Jour. Sci. 49 (1932) 118, 119.

China, Szechwan, Kwanhsien, altitude 3,500 feet, July 25 to August 1, 1937; Pehluting, altitude 6,000 feet, July 9, 1937 (*Franck*). Not included in the Wu Catalogue of Chinese Diptera (1940).

**ORIMARGA (ORIMARGA) FOKIENSIS sp. nov. Plate 1, fig. 13; Plate 4, fig. 37.**

General coloration dark plumbeous gray; antennæ and legs black; halteres with knob weakly darkened; wings relatively broad, brownish gray, stigmal region very narrowly darker brown; macrotrichia of veins beyond cord sparse; $Sc_1$ ending about opposite four-fifths length of Rs, $Sc_2$ at its tip, free tip of the latter atrophied; $R_{1+2}$ and $R_2$ subequal in length, shorter than $R_{2+3}$; anal cells large; abdomen brownish black; male hypopygium with outer dististyle unusually short, apex blackened, shorter than pendant free tip of inner style; gonapophyses very slender, pale, narrowed to an acute point.

*Male.*—Length, about 6 millimeters; wing, 5.

*Female.*—Length, about 6.5 millimeters; wing, 5.3.

Rostrum and palpi black. Antennæ black throughout. Head black, heavily gray-pruinose, broad anterior vertex more silvery.

Mesonotal præscutum dark plumbeous gray, humeral and lateral portions somewhat clearer gray; posterior sclerites of notum gray, posterior border of scutellum narrowly more brownish yellow. Pleura black, pruinose, posterior sclerites and dorsopleural membrane somewhat brightened. Halteres with stem

pale, knob weakly darkened. Legs with coxæ light brown, fore pair of coxæ darker; trochanters brown; remainder of legs black. Wings (Plate 1, fig. 13) relatively broad, especially in male, brownish gray; stigmal region very narrowly darker brown; prearcular field and basal portions of costal region more whitened; veins pale brown, those in prearcular field still lighter. Macrotrichia of veins beyond cord sparse, there being scattered series on distal sections of veins $R_3$ to $M_3$, inclusive; costal fringe moderately long and abundant. Venation: $Sc_1$ ending about opposite four-fifths length of Rs, $Sc_2$ at its tip, free tip of latter atrophied; $R_{1+2}$ and $R_2$ subequal in length, both shorter than $R_{2+3}$; basal section of $R_{4+5}$ very strongly arcuated to angulated; petiole of cell $M_3$ varying from about one-half to more than two-thirds length of cell; anal cells very large and ample, due to the unusually broad wings. The type male shows an adventitious crossvein in cell $R_3$ of the right wing, in direct transverse alignment with r-m and immediately distad of $R_2$.

Abdomen brownish black, hypopygium a trifle brighter. Male hypopygium (Plate 4, fig. 37) with dististyle, *d*, unusually short, apex of outer style shorter than free portion of inner style, narrowly blackened and terminating in a short, acute point; inner style with its free apex pendant, with numerous long setæ. Basistyle, *b*, without lobes of any type. Phallosome with apophyses, *g*, very slender, pale, apex narrowed to an acute point.

*Habitat.*—China, Fukien.

Holotype, male, Kuliang, altitude 1,800 to 2,000 feet, June 1 to 3, 1937 (*Kellogg*). Allotopotype, female, with the type.

*Orimarga* (*Orimarga*) *fokiensis* is closest to species such as *O.* (*O.*) *griseipennis* Alexander (Formosa) and *O.* (*O.*) *gymnoneura* Alexander (Formosa), differing from both in the shape of the wing and in the details of venation. In wing shape the present fly is about intermediate between the two species mentioned, with the venational details correspondingly modified. The male of *griseipennis* is still unknown, but the hypopygium of *gymnoneura* is quite different from that of the present fly.

**DICRANOPTYCHA SUENSONIANA sp. nov. Plate 1, fig. 14; Plate 4, fig. 38.**

General coloration of mesonotal præscutum dark brown, the usual three stripes confluent to form a discal area; posterior sclerites of notum and pleura pruinose; intermediate flagellar segments weakly bicolored; halteres pale yellow; legs yellow,

extreme tips of femora, tibiæ, and basitarsi blackened; wings brownish yellow, costal border conspicuously light yellow; veins dark brown, veins in prearcular and costal fields light yellow; costal fringe short; basal section of $R_{4+5}$ almost in direct longitudinal alignment with Rs; abdomen black, sparsely pruinose, hypopygium abruptly yellow; male hypopygium with outer dististyle flattened, very densely covered with setæ, lower surface before apical spine with blackened tubercles and short triangular spines; phallosome appearing as two pairs of elongate elements, longest pair appearing as acutely pointed blades, before apex on outer margin with a tiny spine.

*Male.*—Length, about 8.5 to 9 millimeters; wing, 10 to 10.5.

*Female.*—Length, about 9 to 10 millimeters; wing, 9.5 to 10.5.

Rostrum black, pruinose; palpi black. Antennæ with basal segments yellow, intermediate and outer segments weakly bicolored, incisures and especially bases of segments yellow, central portion infuscated; outer segments more uniformly infuscated; flagellar segments subcylindrical, passing into elongate-oval. Head black, heavily gray-pruinose; anterior vertex a little less than twice diameter of scape.

Pronotum gray. Mesonotum chiefly dark brown, heavily pruinose, especially posterior sclerites of notum; præscutum with disc almost occupied by a subnitidous dark-brown shield, the three usual stripes being confluent; pseudosutural foveæ black. Pleura heavily gray-pruinose. Halteres pale yellow. Legs with coxæ yellow, weakly pruinose; trochanters yellow; femora, tibiæ, and basitarsi yellow, extreme tips of segments blackened; remainder of tarsi passing into brownish black. Wings (Plate 1, fig. 14) brownish yellow, costal border conspicuously light yellow; veins dark brown, veins in prearcular and costal fields light yellow. Costal fringe short in both sexes. Venation: Basal section of $R_{4+5}$ almost in direct alignment with Rs, $R_{2+3}$ erect at origin; Rs about one and one-half as long as cell 1st $M_2$.

Abdomen black, sparsely pruinose, hypopygium abruptly yellow. Male hypopygium (Plate 4, fig. 38) with interbases appearing as slender, pale rods, a little expanded distally, their extreme tips obtuse and decurved. Outer dististyle, *od,* narrowed to acute blackened apical spine, rather broadly flattened, entire outer surface with very numerous erect setæ, lateral and ventral portions with conspicuous, erect, blackened tubercles

and short triangular spines. Inner dististyle, *id*, longer, gradually narrowed to obtuse tip. Phallosome consisting of two pairs of elongate elements, the longest pair appearing as flattened blades that diverge gradually, narrowed to the acute spinous tips, before apex on outer margin with a very tiny spine. Shorter apophyses, *g*, with apex bent mesad at a right angle into long, very pale points that bear numerous long pale setæ.

*Habitat.*—Japan, Honshiu.

Holotype, male, Kawaguchi, Fuji Lakes District, altitude 2,800 feet, August 11, 1939 (*Suenson*). Allotopotype, female. Paratopotypes, 1 male, 4 females.

I take great pleasure in dedicating this distinct fly to the collector, Mr. E. Suenson, of Shanghai, to whom I am greatly indebted for many Tipulidæ from Japan and eastern China. *Dicranoptycha suensoniana* is closest to *D. prolongata* Alexander, of northern Korea, and to *D. venosa* Alexander, of Saghalien, differing conspicuously from both in the body coloration and especially in the structure of the male hypopygium.

**DICRANOPTYCHA MALABARICA sp. nov. Plate 1, fig. 15; Plate 4, fig. 39.**

General coloration of thorax brownish yellow, pleura clearer yellow; antennæ obscure yellow, outer segments passing into brown; legs yellow, extreme tips of femora, tibiæ, and basitarsi blackened; wings brownish yellow, prearcular and costal fields clear yellow; veins deep yellow to brownish yellow; costal fringe of moderate length, dense; $R_{1+2}$ relatively long, exceeding m-cu in length; abdomen brownish yellow with a narrow, brownish-black, subterminal ring in male, this ring chiefly involving the eighth tergite; male hypopygium with outer dististyle relatively weak, with delicate setulæ and appressed spinous points; apex of inner dististyle dilated; phallosome a complex mass consisting of a dorsal and a ventral portion separated from one another by a distinct notch.

*Male.*—Length, about 7.5 to 8 millimeters; wing, 7.5 to 8.

*Female.*—Length, about 7.5 to 8 millimeters; wing, 7 to 7.5.

Rostrum obscure yellow; palpi light brown. Antennæ obscure yellow, outer segments passing into brown. Head brownish yellow to light brown, more pruinose beneath; anterior vertex somewhat wider than diameter of scape.

Mesonotum brownish yellow, surface, especially of præscutum, subnitidous. Pleura clearer yellow. Halteres pale yellow throughout. Legs with coxæ and trochanters yellow; femora, tibiæ, and basitarsi light yellow, tips very narrowly but con-

spicuously blackened; remaining tarsal segments passing into brown. Wings (Plate 1, fig. 15) with a brownish-yellow tinge, prearcular and costal fields clear yellow; veins deep yellow to brownish yellow. Costal fringe (male) dense and of moderate length. Venation: Rs subequal to or shorter than cell 1st $M_2$; $R_{1+2}$ relatively long, exceeding m-cu in length.

Abdomen brownish yellow, sternites somewhat clearer; in male eighth segment and adjoining portions of seventh and ninth brownish black to form a narrow subterminal ring; hypopygium yellow. Male hypopygium (Plate 4, fig. 39) with outer dististyle, *od*, relatively small and slender, with abundant short, erect setulæ and a few scattered appressed spinous points. Inner dististyle, *id*, much longer, at apex dilated into a discoid head, the whole surface with abundant coarse setæ from conspicuous punctures. Interbase, *i*, a pale, flattened blade, only slightly expanded at distal end, base greatly prolonged to opposite cephalic end of phallosome; apex of interbase with a slightly projecting point. Phallosome, *p*, massive, apex obtuse and provided with abundant delicate setulæ; apex with a broadly circular orifice, margin darker and more sclerotized, in central portion with two small teeth; a shorter portion of phallosome weakly bilobed at apex.

*Habitat.*—South India, Malabar.

Holotype, male, Walayar Forest, altitude 2,000 feet, August 8, 1938 (*Susai Nathan*). Allotopotype, female, in copula with type. Paratopotypes, 30 males and females, altitude 2,000 feet, August 8, 1938, altitude 1,500 feet, September 9, 1938; paratype, 1 female, Siruvani, Coimbatore District, altitude 3,000 feet, August 11, 1938 (*Susai Nathan*).

*Dicranoptycha malabarica* is the first species of the genus to be described from India. There are several members of *Dicranoptycha* in tropical Africa and numerous others in China and Japan, so the occurrence in southern India was not unexpected.

PEDICIINI

**DICRANOTA (EUDICRANOTA) RADIALIS sp. nov. Plate 1, fig. 16.**

General coloration yellow; antennæ 15-segmented, flagellar segments short and crowded, especially the basal ones; mesonotal præscutum and scutal lobes caseous; tips of tibiæ and proximal two tarsal segments narrowly dark brown; wings whitish subhyaline, very sparsely patterned with brown, appearing as small and narrow seams on certain of the veins; Rs long, angulated at origin; a supernumerary crossvein in cell

$R_1$ at near one-third length of Rs, additional to usual crossvein lying beyond midlength of cell; $R_2$ very oblique, ending in costa or barely connected at its tip with $R_1$; m-cu just beyond fork of M.

*Female.*—Length, about 7 millimeters; wing, 6.8.

Rostrum and palpi yellow. Antennæ short, yellow throughout, 15-segmented; flagellar segments short and crowded, basal segments not narrowed apically and thus joined broadly with succeeding segments; outer segments more oval, with longer verticils. Head pale yellow.

Pronotum pale yellow. Mesonotal præscutum and scutal lobes pale grayish brown or caseous, median region of scutum, scutellum, and postnotum yellow; setigerous punctures of præscutum conspicuous. Pleura pale yellow. Halteres yellow. Legs relatively stout, yellow, tips of tibiæ and proximal two tarsal segments narrowly dark brown, remainder of tarsi uniformly dark brown. Wings (Plate 1, fig. 16) whitish subhyaline, very sparsely patterned with brown, appearing as small and narrow seams on $Sc_2$, origin of Rs, along both supernumerary crossveins in cell $R_1$, along $R_2$, and less evidently along cord and outer end of cell 1st $M_2$; a distinct grayish marginal cloud at end of vein $R_3$; veins beyond cord chiefly dark brown, veins basad of cord and in costal region yellow except where traversing dark areas. Venation: $Sc_2$ lying far basad, distance between arculus and vein only equal to cell 1st $M_2$; Rs long, angulated and sometimes spurred at origin, with a strong supernumerary crossvein at near one-third its length in cell $R_1$, as well as the usual *"Dicranota"* crossvein farther distad, about opposite fork of $R_{4+5}$; a weaker crossvein at near one-third length of cell $R_3$; vein $R_2$ very oblique, ending in costa beyond tip of $R_1$ or barely fused with this vein; vein $R_3$ unusually short and upcurved at its outer end, a little exceeding twice length of vein $R_2$; cell $M_1$ a little exceeding its petiole; m-cu shortly beyond fork of M.

Abdomen obscure yellow; cerci long and powerful, yellowish horn-colored.

*Habitat.*—Manchuria, Kirin.

Holotype, female, Kaolingtzu, June 20, 1940 (*Weymarn*).

*Dicranota* (*Eudicranota*) *radialis* is closest to *D.* (*E.*) *perdistincta* Alexander, of northern Korea. I must regard the strong crossvein connecting vein $R_1$ with Rs as a supernumerary rather than an adventitious element and thus furnishing a marked

specific character for the separation of the two species. Whether the further crossvein in cell $R_3$ is also supernumerary cannot be affirmed. The larger size, more fully developed wings, and caseous color of the præscutum give a distinctive appearance to the present fly. In *perdistincta,* and presumably also in *radialis,* the halteres of the female are shorter than those of the male.

HEXATOMINI

LIMNOPHILA (ELÆOPHILA) LATINIGRA sp. nov. Plate 1, fig. 17; Plate 4, fig. 40.

General coloration gray, præscutum with six broken series of brown spots and dots; antennal flagellum bicolored; pleura gray, conspicuously patterned with dark brown; base of knob of haltere whitish; femora yellow, tips very broadly black, including approximately one-fifth total length of segment; wings whitish, with a heavy brown spotted and dotted pattern; abdomen brownish black, hypopygium brightened; male hypopygium with apical portion of outer dististyle almost central in position, apex a right-angled spine subtended on either side by conspicuous lobes; ædeagus very small, on either side with a small, acute, triangular point.

*Male.*—Length, about 5.5 millimeters; wing, 6.

Rostrum black, sparsely pruinose; palpi black. Antennæ with basal two segments black, sparsely pruinose; succeeding segments bicolored, their bases black, the apical half or less yellow, the amount of latter decreasing on outer segments; terminal segments uniformly black; basal flagellar segments elongate, outer segments shorter. Head gray, center of vertex chiefly dark brown.

Thoracic notum gray, variegated with short brown dashes, including a central dash on pronotum and six broken series on præscutum, representing the usual stripes and interspaces; tuberculate pits and pseudosutural foveæ black; scutum gray, each lobe with two separate dark-brown areas; scutellum narrowly transverse, dark gray, parascutella darker; mediotergite gray, lined with darker. Pleura gray, conspicuously patterned with dark brown, including two irregular and partly broken longitudinal stripes. Halteres with base of stem yellow, remainder brown; base of knob whitish, apex dark brown. Legs with coxæ dark brown, gray-pruinose; trochanters black; femora yellow, tips broadly and abruptly jet black, the amount involving about one-fifth the total length of segment; tibiæ yellow, tips narrowly blackened; tarsi obscure yellow, apices of

basitarsi and all of outer segments darkened. Wings (Plate 1, fig. 17) only moderately widened in male, broadest at or just before midlength; ground color whitish, extreme wing base more yellowed; a very abundant dark-brown spotted and dotted pattern; major dark areas at arculus; as a narrow complete band at level of origin of Rs and supernumerary crossvein, ending at outer end of cell 2d A a short distance before vein 2A; a dark V with the point on the anterior cord, the arms at fork of Sc and the stigma; wing tip darkened, broken by abundant small dots; all cells with abundant small brown dots; veins yellow, infumated in darkened areas. Venation: $Sc_1$ ending just before fork of Rs, $Sc_2$ at its tip; $R_2$ subequal to $R_{2+3}$; $R_{2+3+4}$ in longitudinal alignment with Rs; m-cu about two-thirds its length beyond fork of M.

Abdomen brownish black, sparsely pruinose; hypopygium brightened. Male hypopygium (Plate 4, fig. 40) with outer dististyle, *od,* broad, apical point almost central in position, at apex strongly curved to a right angle; outer shoulder an acutely pointed flange, inner lobe more obtusely rounded; setæ on face of style sparse. Inner dististyle, *id,* pale, subobtuse at apex. Phallosome, *p,* with ædeagus very small, subtended on either side by a small, acute, triangular point.

*Habitat.*—China, Fukien.

Holotype, male, Kuliang, altitude 1,500 to 2,500 feet, April 6 to 13, 1938 (*Kellogg*).

*Limnophila* (*Elæophila*) *latinigra* is most similar to species such as *L.* (*E.*) *dietziana* Alexander and *L.* (*E.*) *suensoni* Alexander, differing conspicuously in the very broad blackened femoral tips and, especially, in the distinctive structure of the male hypopygium.

LIMNOPHILA (ELÆOPHILA) SIMILISSIMA sp. nov. Plate 4, fig. 41.

General coloration gray, præscutum variegated with short, dark-brown lines; basal flagellar segments yellow; femora yellow, tips broadly blackened, on outer face close to apex more reddish brown; wings (male) dilated, widest before tip of vein 2d A; whitish, heavily spotted and dotted with brown; male hypopygium with outer dististyle narrow, subtended on outer face by a relatively slender lobe, its tip narrowly obtuse; ædeagus with subtending lobes low and obtuse.

*Male.*—Length, about 5.5 millimeters; wing, 6.2.

Rostrum and palpi black. Antennæ with scape and pedicel black; basal flagellar segments uniformly yellow, outer segments

darker; flagellar segments oval. Head brownish gray, sparsely patterned with darker.

Pronotum gray, with a delicate median brown line. Mesonotal præscutum gray with short, dark-brown lines, representing the usual stripes, with additional dashes on posterior interspaces; scutum gray, each lobe with two brown areas; scutellum gray, with a narrow brown median line that likewise includes the central area of scutum; postnotum gray, mediotergite darkened behind and on sides. Pleura conspicuously variegated with dark brown on a gray ground. Halteres dark brown, base of stem restrictedly pale, extreme tip of stem slightly brightened. Legs with coxæ gray; trochanters blackish; femora yellow, tips broadly blackened, outer face close to apex more reddish; tibiæ yellow, tips very weakly infuscated; basal tarsal segments yellow, extreme tips vaguely darkened; outer tarsal segments uniformly darkened. Wings of male dilated, widest just basad of vein 2d A; ground color whitish, heavily patterned with brown spots and dots; major brown areas at and just beyond arculus; as a narrow broken band at level of origin of Rs and supernumerary crossvein, interrupted in cell Cu; a large V-shaped area with arms at fork of Sc and stigma, converging to a point behind, enclosing a very narrow ground area between branches; wing tip broadly and almost solidly darkened; numerous small dots in interspaces; veins pale, brown in clouded areas. Venation: $Sc_1$ ending a short distance beyond fork of Rs, $Sc_2$ at its tip; $R_{2+3+4}$ in longitudinal alignment with Rs, the latter square and short-spurred at origin; m-cu at near midlength of the small cell 1st $M_2$.

Abdomen dark brown, hypopygium a trifle brightened. Male hypopygium (Plate 4, fig. 41) with outer dististyle, *od,* narrow, subtended on outer face by a relatively slender lobe or flange, apex narrowly obtuse; apical spine gently curved to acute tip, on inner face gradually sloping. Inner dististyle, *id,* entirely pale. Phallosome, *p,* with ædeagus relatively large and conspicuous, lateral subtending lobes low and obtuse.

*Habitat.*—China, Szechwan.

Holotype, male, Mount Omei, Flying Bridges, altitude 3,000 feet, June 1, 1938 (*Tsen*).

*Limnophila* (*Elæophila*) *similissima* is very like the Japanese *L.* (*E.*) *dietziana* Alexander, differing in the nature of the wing and leg pattern and especially in the details of structure of the male hypopygium. It is quite distinct from the only

other species of *Elæophila* hitherto made known from western China.

**LIMNOPHILA TRANSITORIA sp. nov. Plate 1, fig. 18; Plate 4, fig. 42.**

Allied to *nemoralis;* general coloration light gray, præscutum with very slightly darker-gray stripes; basal antennal segments pale; wings with a strong brownish-yellow tinge, stigmal region very slightly darker brown; cell $M_1$ lacking; abdominal tergites light brown, subterminal segments forming a blackened ring; male hypopygium with interbases only feebly expanded at outer ends.

*Male.*—Length, about 5 to 6 millimeters; wing, 5.8 to 6.8.

Rostrum brown, pruinose; palpi black. Antennæ short; scape pruinose; succeeding two or three segments brownish yellow, outer segments passing into brown; flagellar segments elongate, verticils long and conspicuous. Head light gray; anterior vertex broad.

Pronotal scutellum yellow. Thoracic dorsum light gray, præscutal stripes very slightly darker gray, only slightly differentiated against ground. Pleura chiefly pale, gray-pruinose, ventral sternopleurite and dorsopleural region darker gray. Halteres yellow. Legs with coxæ testaceous yellow to brownish yellow; trochanters yellow; femora yellowish brown, slightly darkened on outer portion; remainder of legs obscure yellow to brownish yellow, terminal tarsal segments blackened. Wings (Plate 1, fig. 18) with a strong brownish-yellow tinge, stigmal region very slightly darker brown; veins brownish yellow to very pale brown. Venation: Cell $M_1$ lost by fusion to margin of veins $M_1$ and $M_2$; m-cu beyond fork of M, the distance variable, in cases only a little less than vein itself.

Abdominal tergites light brown, sternites obscure yellow or brownish yellow; subterminal segments, including seventh and eighth, forming a blackened ring; hypopygium yellow. Male hypopygium (Plate 4, fig. 42) with outer dististyle, *od,* unequally bifid at apex, inner or lower tooth longer and stouter. Interbase, *i,* only feebly expanded at outer end.

*Habitat.*—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, June 19, 1939 (*Suenson*). Paratopotypes, 4 males, June 18 and 19, 1939.

Among the described regional species of the *nemoralis* group the present fly is closest to *Limnophila subnemoralis* Alexander, of Japan. The described species of the group, including the western Palæarctic *L. adjuncta* Walker, and *L. nemoralis*

(Meigen) and its described races, *minuscula* Edwards, *separata* Walker, and *quadrata* Edwards; the eastern Palæarctic and Oriental *L. inæqualis* Alexander, *L. nesonemoralis* Alexander, and *L. subnemoralis* Alexander; and the Nearctic *L. brevifurca* Osten Sacken and *L. occidenta* Alexander, all have cell $M_1$ present but in cases very small and with abnormal individuals showing the cell lost by fusion of veins in one or even in both wings. The present series indicates that the character of loss of cell $M_1$ in the present species is a constant one. The case is comparable to that found in *Pseudolimnophila noveboracensis* (Alexander) and others where cell $M_1$ is lacking, although it is present in numerous allied species of the genus.

**HEXATOMA (ERIOCERA) COOMANI sp. nov. Plate 1, fig. 19.**

Belongs to the *chirothecata* group; mesonotal præscutum dark brown, with four shiny blue-black stripes that are narrowly margined with velvety black; posterior sclerites of notum and abdomen black; halteres and legs black throughout; wings with a strong brown tinge, costal border with a more yellowish cast; $R_{1+2}$ long; cells $M_1$ short; m-cu at near midlength of the small cell 1st $M_2$.

*Male.*—Length, about 13 millimeters; wing, 10.

Rostrum black, sparsely pruinose; palpi black. Antennæ with scape and pedicel black; flagellum broken. Head black, very sparsely pruinose; anterior vertex wide, approximately four times diameter of scape.

Pronotum black, sparsely pruinose. Mesonotal præscutum dark brown with four shiny blue-black stripes that are narrowly margined with velvety black, pruinose portions with long, black setæ; posterior sclerites of notum black, surface subnitidous. Pleura black, surface pruinose, opaque; dorsopleural membrane dark. Halteres black throughout. Legs with coxæ black-pruinose; trochanters black; remainder of legs black; claws (male) with a strong basal tooth. Wings (Plate 1, fig. 19) with a strong brown tinge, base and costal region more suffused, with a yellowish cast especially in cells C and Sc; stigma lacking; veins brown. Outer radial veins with numerous trichia; outer branches of M without trichia except on $M_1$ and $M_2$. Venation: Sc long, $Sc_1$ ending shortly beyond $R_2$, $Sc_2$ far from its tip, lying just before fork of $R_{2+3+4}$; $R_{1+2}$ long, approximately one-half Rs; $R_{2+3+4}$ long, nearly twice basal section of $R_5$; outer medial veins very delicate and faint; cell $M_1$ small, only about one-half as long as its petiole, fork asymmetrical, with $M_1$

arcuated, $M_2$ in longitudinal alignment with $M_{1+2}$; cell 1st $M_2$ relatively small, subequal in length to vein $M_4$ beyond it, m-cu at near middle of its length.

Abdomen, including hypopygium, polished black.

*Habitat.*—French Indo-China, Tonkin.

Holotype, male, Hoa-binh (*Cooman*); Musée Heude.

This distinct species is named in honor of the collector, Mr. A. de Cooman. By Edwards's key to the Old World species of *Eriocera*[2] the present fly runs to couplet 37, disagreeing with all species in the *chirothecata* group, coming closest to the otherwise entirely distinct *H.* (*E.*) *waterstoni* (Edwards), of Macedonia.

HEXATOMA (ERIOCERA) TONKINENSIS sp. nov. Plate 1, fig. 20.

Belongs to *pyrrhochroma* group; general coloration of thorax orange, without markings except a small brown spot on dorsal mesepisternum before wing root; antennal scape yellow, pedicel and flagellum black; legs brown, femoral bases restrictedly obscure yellow; wings with a brown tinge, costal field more saturated; stigma small, dark brown; cell $M_1$ longer than its petiole; m-cu at near one-third length of cell 1st $M_2$; abdomen, including hypopygium, orange.

*Male.*—Length, about 10 millimeters; wing, 11.5 antenna, about 1.8.

Rostrum brownish yellow; palpi black. Antennæ short, 8-segmented; scape yellow, pedicel and flagellum black; flagellar segments elongate, gradually decreasing in length; terminal segment about one-half length of penultimate. Head orange; vertical tubercle low.

Prothorax and mesothorax uniformly deep orange, præscutum glabrous; a single brown spot on extreme dorsal portion of anepisternum in front of wing root. Halteres with stem brownish yellow, knob brownish black. Legs with coxæ orange; trochanters obscure yellow; femora dark brown, bases restrictedly obscure yellow; tibiæ and tarsi dark brown; claws (male) toothed. Wings (Plate 1, fig. 20) narrow, with a brownish tinge, prearcular and costal fields still darker brown; stigma very small and narrow, dark brown; vague dark seams along certain of the veins, including Rs and Cu; cell Sc yellow; veins brown. Abundant macrotrichia on veins beyond cord, except for distal section of $Cu_1$. Venation: $Sc_1$ ending just

[2] Ann. & Mag. Nat. Hist. (9) 8 (1921) 70–78.

beyond fork of $R_{2+3+4}$, $Sc_2$ some distance from its tip, shortly beyond fork of Rs; cell $M_1$ longer than its petiole; m-cu at near one-third length of cell 1st $M_2$, latter about twice as long as wide.

Abdomen, including hypopygium, orange, pleural region vaguely darker.

*Habitat.*—French Indo-China, Tonkin.

Holotype, male, Laokay, August 13, 1934 (*C. Brownell*); Lingnan University.

Most nearly related to *Hexatoma* (*Eriocera*) *nigronotata* Alexander, of Mindanao, and to *H.* (*E.*) *quadriatrata* Alexander, of southeastern China, differing in the coloration of the body and wings, and in the details of venation. The dark pattern of the mesothorax is here limited to a small brown spot on the dorsal mesepisternum.

ERIOPTERINI

**GONOMYIA (LIPOPHLEPS) BIMUCRONATA sp. nov. Plate 1, fig. 21; Plate 4, fig. 43.**

Belongs to the *incompleta* group; antennæ black, relatively elongate, in male segments with a dense, erect, white pubescence but without elongate verticils; mesonotum grayish brown, variegated with yellow on scutellum and median region of scutum; posterior pleurites yellow; legs brown; wings tinged with brown; Sc short; male hypopygium with a single bispinous dististyle, second spine shorter and placed on concave margin of style.

*Male.*—Length, about 2.5 millimeters; wing, 3.2.

Rostrum obscure orange; palpi dark brown. Antennæ (male) brownish black throughout, relatively elongate for a member of this subgenus; flagellar segments subcylindrical to fusiform, with a dense, erect, white pubescence but without elongate verticils, these being only about one-half length of segment. Head dark.

Anterior pretergites light yellow. Mesonotal præscutum and scutal lobes uniformly dark grayish brown, humeral region of præscutum restrictedly brightened; median region of scutum, posterior borders of scutal lobes, and broad apical margin of scutellum yellow; base of scutellum and adjoining portions of scutum darkened; mediotergite dark brown, sparsely pruinose. Pleura chiefly light yellow, including posterior sternopleurite, pteropleurite, meral region, and pleurotergite, ventral sternopleurite, and anepisternum somewhat darker. Halteres pale, knobs weakly darkened. Legs with fore coxæ darkened, re-

maining coxæ and all trochanters somewhat more testaceous; remainder of legs brown, femoral bases scarcely brightened. Wings (Plate 1, fig. 21) with a brownish tinge, prearcular region and cells C and Sc pale yellow; stigma diffuse, darker brown than ground; veins brown. Venation: $R_{1+2}$ reaching costa but without trichia on extreme outer portion; Sc short, $Sc_1$ ending shortly before origin of Rs, latter shorter than its anterior branch; cell $R_5$ very strongly narrowed at outer end; m-cu at fork of M; cell 2d A wide.

Abdomen brown, sternites very little brighter; hypopygium obscure yellow. Male hypopygium (Plate 4, fig. 43) with dististyles, *d*, symmetrical. Outer lobe of basistyle, *b*, stout, extending about to opposite level of apex of dististyle. Dististyle, *d*, conspicuously bispinous, outer spine longer, slenderer, gently curved; second spine on concave margin at near midlength of style; surface of style with setigerous punctures, as figured. Phallosome, *p*, of the general type, of the *incompleta* group, terminal bilobed portion very narrow at base.

*Habitat.*—Philippines, Luzon.

Holotype, male, Batangas Province, Balayan, August 25, 1932 (*Rivera*).

*Gonomyia* (*Lipophleps*) *bimucronata* is most nearly allied to *G.* (*L.*) *incompleta* Brunetti (Japan to British India), differing markedly in the structure of the male hypopygium. The phallosome is much alike in all members of the group but the dististyles show unusually strong characters. In *incompleta* the dististyle is slender, prolonged into a slender apical spine, with a small tubercle or weak spine on the outer or convex face at base of spine. There is a slight difference in the dististyles of the two sides in *incompleta* but nothing to approach the asymmetry found in the allied *G.* (*L.*) *inaequistyla* Alexander (Mindanao to Celebes). In the other two Philippine members of the group, *G.* (*L.*) *maquilingia* Alexander and the present fly, the dististyles of the two sides are entirely alike.

GONOMYIA (GONOMYIA) HORRIBILIS sp. nov. Plate 1, fig. 22; Plate 4, fig. 44.

Belongs to the *noveboracensis* group; antennæ black throughout; thoracic pleura striped longitudinally with brown and yellow; wings brownish yellow, stigma vaguely darker but undelimited; Rs shorter than the long, nearly straight $R_{2+3+4}$; male hypopygium with three dististyles; phallosome of unusual size and complexity, there being about six spinous points and branches on either side, some of these arms further complicated by delicate, pale setulæ.

*Male.*—Length, about 5 millimeters; wing, 5.5.

*Female.*—Length, about 6 millimeters; wing, 6.

Rostrum obscure yellow or brownish yellow; palpi black. Antennæ black throughout; flagellar segments elongate, with long, conspicuous verticils, especially on intermediate segments. Head dark gray, occipital region obscure yellow medially.

Pronotum yellow above, more obscure on sides. Mesonotum almost uniform brownish gray, scutellum extensively obscure yellow. Pleura and pleurotergite obscure yellow, with a conspicuous, brown, longitudinal stripe extending from cervical region across dorsal pleurites, ending on pteropleurite; ventral sternopleurite somewhat less evidently darkened. Halteres pale. Legs with coxæ and trochanters yellow; remainder of legs brownish yellow, tarsal segments passing into black. Wings (Plate 1, fig. 22) with a brownish-yellow suffusion, prearcular and costal fields clearer yellow; stigmal region vaguely darker, undelimited; veins brown, prearcular veins, Sc and $Cu_2$, clearer yellow. Venation: $Sc_1$ ending opposite origin of Rs, $Sc_2$ at its tip; Rs shorter than the long, nearly straight $R_{2+3+4}$; m-cu about one-half its length beyond fork of M.

Abdominal tergites dark brown, pruinose, the narrow caudal borders of the segments and the pleural membrane yellow; sternites more uniformly yellow; genital segment obscure yellow. Male hypopygium (Plate 4, fig. 44) of unusual complexity, especially in the details of the phallosome, *p*. Basistyle, *b*, on mesal face before apex with a tubercle bearing three strong, powerful setæ. Three dististyles, the outer, *od*, longest, slender, distal portion a little expanded; intermediate style, *md*, shorter, very widely expanded at distal end, truncate or gently concave margin with about a dozen pale setæ in a linear row; inner style, *id*, shortest, appearing as a boomerang-shaped structure terminating in several long setæ, including usual fasciculate pair; outer margin of style at midlength expanded into a pale flange bearing two separated, pale, spinous setæ; at base of this flange a further triangular pale blade or lobe. Phallosome, *p*, of unusual complexity, as roughly shown by the figure, where only the structures of a single side are shown; there are no less than six such arms and branches, of which three bear delicate setæ; of the glabrous rods one is very small and inconspicuous; at the base of the phallosome are two short, blackened lobes that are densely set with short setulæ. Besides the parts shown, the phallosomic mass shows still further complexities of hair brushes that cannot be describe at this time.

*Habitat.*—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, June 13, 1939 (*Suenson*). Allotopotype, female, pinned with type. Paratopotypes, 3 females, June 13 to July 24, 1939.

The only described species of the *noveboracensis* group are the western Palæartic *Gonomyia* (*Gonomyia*) *edwardsi* Lackschewitz and G. (*G.*) *ithyphallus* Lackschewitz, the eastern Nearctic *G.* (*G.*) *noveboracensis* Alexander, and the western Nearctic *G.* (*G.*) *aciculifera* Alexander. The discovery of a species in the eastern Palæarctic region is thus of very great interest. All five species have the dististyles of the male hypopygium of the approximate nature above described and all have the tremendously complicated phallosome, the species differing among themselves in various details of structure of both the styli and the phallosome.

**ORMOSIA (ORMOSIA) DEPRAVA sp. nov. Plate 1, fig. 23.**

Allied to *prava;* general coloration of body polished black; antennæ black; halteres pale yellow; femora yellow, tips broadly blackened; wings yellow, heavily washed and clouded with brown, especially along cord and veins Cu and 2d A; $Sc_2$ about opposite one-third length of Rs; cell 1st $M_2$ small, only about one-half as long as vein $M_4$ beyond it; caudal borders of abdominal tergites and sternites narrowly obscure yellow.

*Female.*—Length, about 8 millimeters; wing, 7.

Rostrum black; palpi dull black. Antennæ black throughout; flagellar segments oval, ends truncated; outer segments more elongate; longest verticils exceeding segments. Head black.

Thorax uniformly black, surface nitidous, especially præscutum. Halteres pale yellow, stem more whitened. Legs with coxæ black; trochanters brownish yellow; femora yellow, tips broadly blackened, unequally so on various legs, on fore pair involving about distal half, on middle and hind legs about distal third; tibiæ and basitarsi brownish black, tips narrowly blackened, posterior tibiæ paler than remaining tibiæ; remainder of tarsi black. Wings (Plate 1, fig. 23) with ground color yellow, conspicuously washed and clouded with brown; stigma long-oval, dark brown; broad washes the entire length of vein Cu in both cells M and Cu; a similar seam along vein 2d A involving cells on either side; a very extensive cloud along cord, slightly involving cells basad of cord but especially suffusing bases of outer radial and medial cells, appearing as seams to certain of the veins to the wing tip or nearly so;

prearcular and costal fields uniformly clear yellow; veins yellow in the flavous areas, brown in the infuscated portions. Macrotrichia of cells abundant, involving all cells of wing. Venation: Sc long, $Sc_1$ ending just before $R_2$, $Sc_2$ far from its tip, about opposite one-third length of Rs; Rs long and straight; $R_2$ just beyond fork of $R_{2+3+4}$; veins $R_3$ and $R_4$ turned slightly upward or cephalad; cell 1st $M_2$ small, rectangular, only about one-half length of vein $M_4$ beyond it; m-cu about one-fourth to one-fifth its length beyond fork of M; vein 2d A only gently sinuous, cell wide.

Abdomen polished black, caudal margins of both tergites and sternites narrowly obscure brownish yellow; genital segment black; valves of ovipositor yellow.

*Habitat.*—Japan, Honshiu.

Holotype, female, Kamikochi, altitude 5,000 feet, June 13, 1939 (*Suenson*).

Most closely allied to *Ormosia* (*Ormosia*) *prava* Alexander, of northern Korea. In the female sex the two species differ especially in the coloration of the wings and legs, and in the venation, as the more elongate $R_{2+3+4}$ of the present fly.

**ORMOSIA (ORMOSIA) NIPPOALPINA sp. nov. Plate 1, fig. 24; Plate 4, fig. 45.**

Belongs to the *nigripila* group; general coloration polished black; wings with a strong brown tinge; $R_{2+3+4}$ relatively short, about one and one-half as long as basal section of $R_5$; cell 1st $M_2$ open by atrophy of m; petiole of cell $M_3$ short, subequal to or shorter than m-cu; anal veins divergent; male hypopygium with ædeagus subtended by broadly flattened and depressed pale phallosomic plates.

*Male.*—Length, about 4.5 millimeters; wing, 5.3.

*Female.*—Length, about 5 millimeters; wing, 5.7.

Rostrum and palpi black. Antennæ brownish black throughout, of moderate length, if bent backward extending nearly to wing root; flagellar segments oval to long-oval, longest verticils very conspicuous, nearly twice as long as segment; a dense white pubescence additional to verticils. Head black.

Thorax uniformly polished black, only pronotal scutellum and very restricted anterior lateral pretergites clear light yellow, the latter color even more obscured in the female. Halteres pale, knobs clear light yellow. Legs with coxæ black; trochanters brown; remainder of legs black, femoral bases restrictedly yellow, more conspicuous on forelegs. Wings (Plate 1, fig. 24)

with a strong brown tinge, prearcular portion clearer yellow; veins pale brown, more brightened in the flavous portions. Macrotrichia of cells relatively abundant, lacking in the cells at and near the region of arculus. Venation: $R_{2+3+4}$ relatively short, about one and one-half as long as basal section of $R_5$; $R_2$ a little exceeding $R_{2+3}$; cell $M_2$ open by atrophy of m; petiole of cell $M_3$ short, subequal to or shorter than m-cu; anal veins divergent.

Abdomen, including hypopygium, polished black. Ovipositor with cerci horn-yellow, blackened at bases. Male hypopygium (Plate 4, fig. 45) with structure of dististyles, *id, od,* much as in other members of *nigripila* group, apical point of outer style, *od,* relatively short. Ædeagus subtended by broadly flattened and depressed pale phallosomic plates, *p.*

*Habitat.*—Japan, Honshiu.

Holotype, male, Kamikochi, altitude 5,000 feet, June 23, 1939 (*Suenson*). Allotopotype, female, with the type.

The present fly is entirely distinct from *Ormosia* (*Ormosia*) *diversipes* Alexander, the only other Japanese member of the group, in its open cell 1st $M_2$, polished-black coloration of the thorax, and in the structure of the male hypopygium. In the present fly the legs are similarly blackened in both sexes, not being differently colored in the males and females, as in *diversipes* and in *O.* (*O.*) *nigripennis* Alexander, of western China.

ERRATUM

Due to a regrettable oversight certain of the illustrations for Parts XLI [Phil. Jour. Sci. 71 (1940) 75] and XLII [Phil. Jour. Sci. 71 (1940) 203] of this series have been transposed. Plate 1 at the end of Part XLI belongs to Part XLII, and Plate 1 at the end of Part XLII belongs to Part XLI. The author has kindly corrected the error in all the reprints distributed by him.—EDITOR.

# ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite.]

## PLATE 1

FIG. 1. *Tanyptera chrysophæa* sp. nov.; venation.
2. *Ctenacroscelis persessilis* sp. nov.; venation.
3. *Tipula* (*Yamatotipula*) *kamikochiensis* sp. nov.; venation.
4. *Tipula* (*Acutipula*) *receptor* sp. nov.; venation.
5. *Tipula* (*Schummelia*) *crastina* sp. nov.; venation.
6. *Tipula* (*Oreomyza*) *lacunosa* sp. nov.; venation.
7. *Tipula* (*Oreomyza*) *subdepressa* sp. nov.; venation.
8. *Nephrotoma alticrista* sp. nov.; venation.
9. *Nephrotoma circumcincta* sp. nov.; venation.
10. *Cylindrotoma angustipennis* sp. nov.; venation.
11. *Limonia* (*Dicranomyia*) *poli* sp. nov.; venation.
12. *Limonia* (*Dicranomyia*) *retrograda* sp. nov.; venation.
13. *Orimarga* (*Orimarga*) *fokiensis* sp. nov.; venation.
14. *Dicranoptycha suensoniana* sp. nov.; venation.
15. *Dicranoptycha malabarica* sp. nov.; venation.
16. *Dicranota* (*Eudicranota*) *radialis* sp. nov.; venation.
17. *Limnophila* (*Elæophila*) *latinigra* sp. nov.; venation.
18. *Limnophila transitoria* sp. nov.; venation.
19. *Hexatoma* (*Eriocera*) *coomani* sp. nov.; venation.
20. *Hexatoma* (*Eriocera*) *tonkinensis* sp. nov.; venation.
21. *Gonomyia* (*Lipophleps*) *bimucronata* sp. nov.; venation.
22. *Gonomyia* (*Gonomyia*) *horribilis* sp. nov.; venation.
23. *Ormosia* (*Ormosia*) *deprava* sp. nov.; venation.
24. *Ormosia* (*Ormosia*) *nippoalpina* sp. nov.; venation.

## PLATE 2

FIG. 25. *Tanyptera chrysophæa* sp. nov.; female antenna.
26. *Tipula* (*Yamatotipula*) *kamikochiensis* sp. nov.; male hypopygium.
FIGS. 27 and 28. *Tipula* (*Acutipula*) *receptor* sp. nov.; male hypopygium.
FIG. 29. *Tipula* (*Schummelia*) *crastina* sp. nov.; male hypopygium.

## PLATE 3

FIG. 30. *Tipula* (*Oreomyza*) *lacunosa* sp. nov.; male hypopygium.
FIGS. 31 to 33. *Tipula* (*Oreomyza*) *subdepressa* sp. nov.; male hypopygium.
FIG. 34. *Nephrotoma alticrista* sp. nov.; male hypopygium.
35. *Limonia* (*Dicranomyia*) *poli* sp. nov.; male hypopygium.
36. *Limonia* (*Dicranomyia*) *retrograda* sp. nov.; male hypopygium.

PLATE 4

FIG. 37. *Orimarga* (*Orimarga*) *fokiensis* sp. nov.; male hypopygium.
38. *Dicranoptycha suensoniana* sp. nov.; male hypopygium.
39. *Dicranoptycha malabarica* sp. nov.; male hypopygium.
40. *Limnophila* (*Elæophila*) *latinigra* sp. nov.; male hypopygium.
41. *Limnophila* (*Elæophila*) *similissima* sp. nov.; male hypopygium.
42. *Limnophila transitoria* sp. nov.; male hypopygium.
43. *Gonomyia* (*Lipophleps*) *bimucronata* sp. nov.; male hypopygium.
44. *Gonomyia* (*Gonomyia*) *horribilis* sp. nov.; male hypopygium.
45. *Ormosia* (*Ormosia*) *nippoalpina* sp. nov.; male hypopygium.

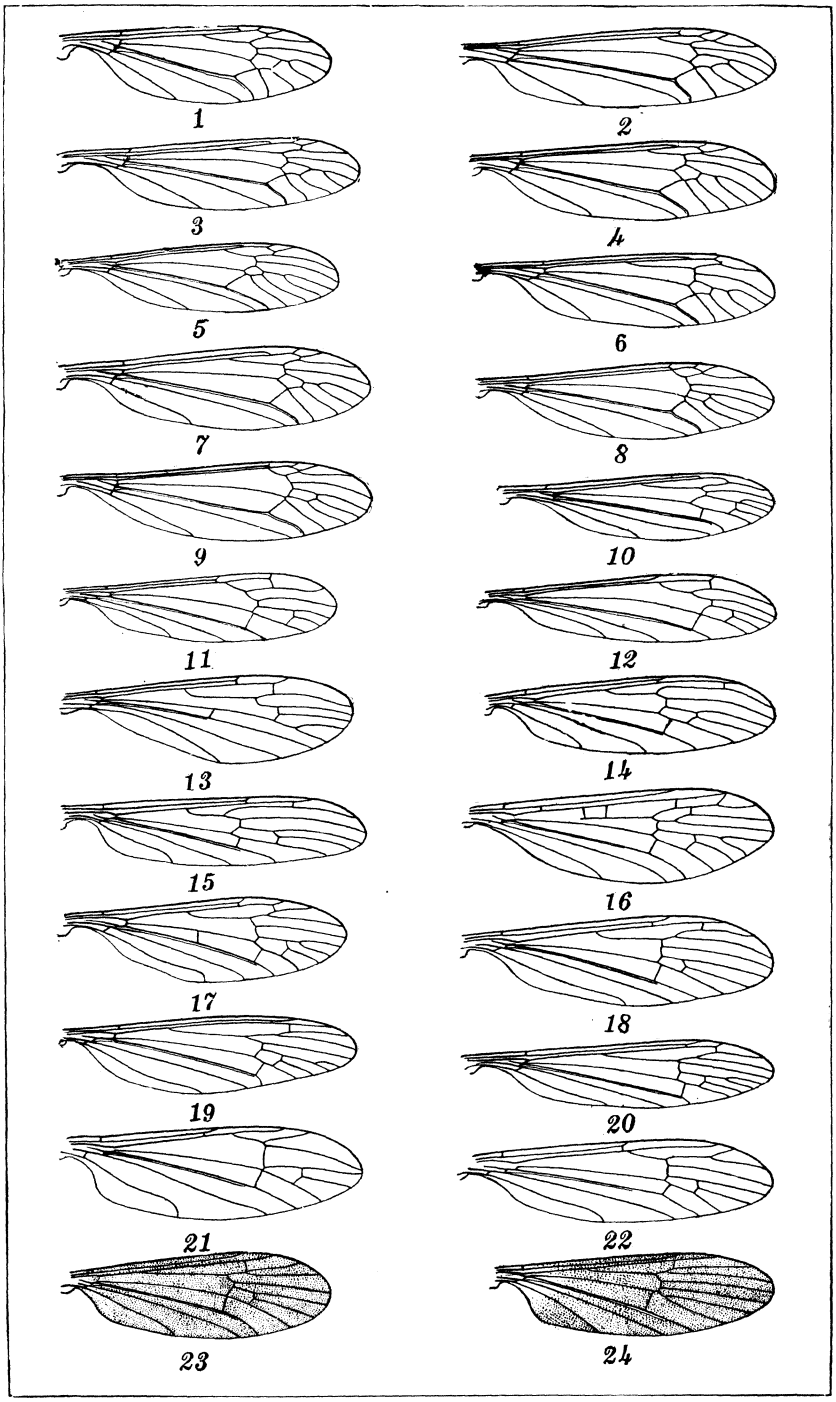


PLATE 1.

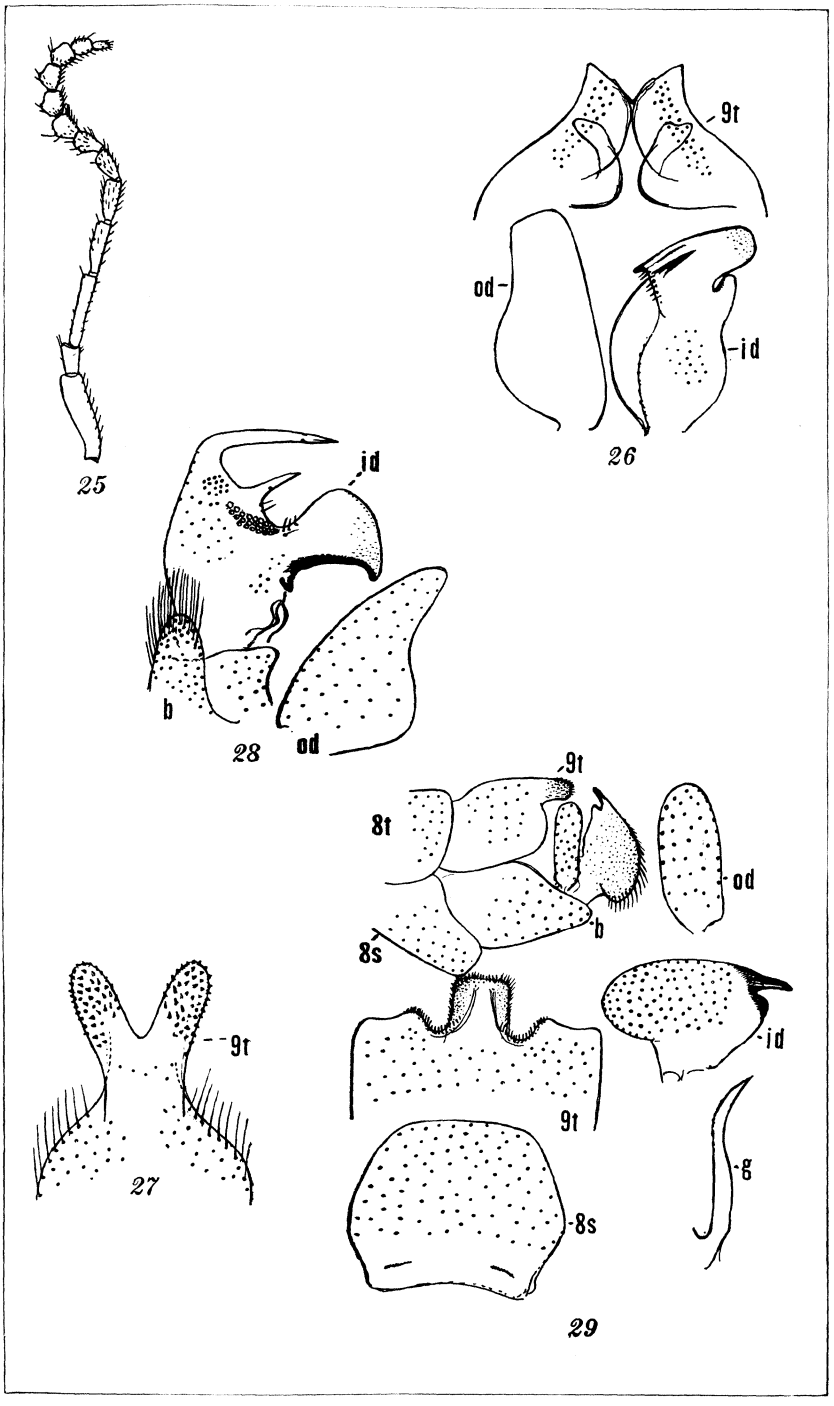


PLATE 2.

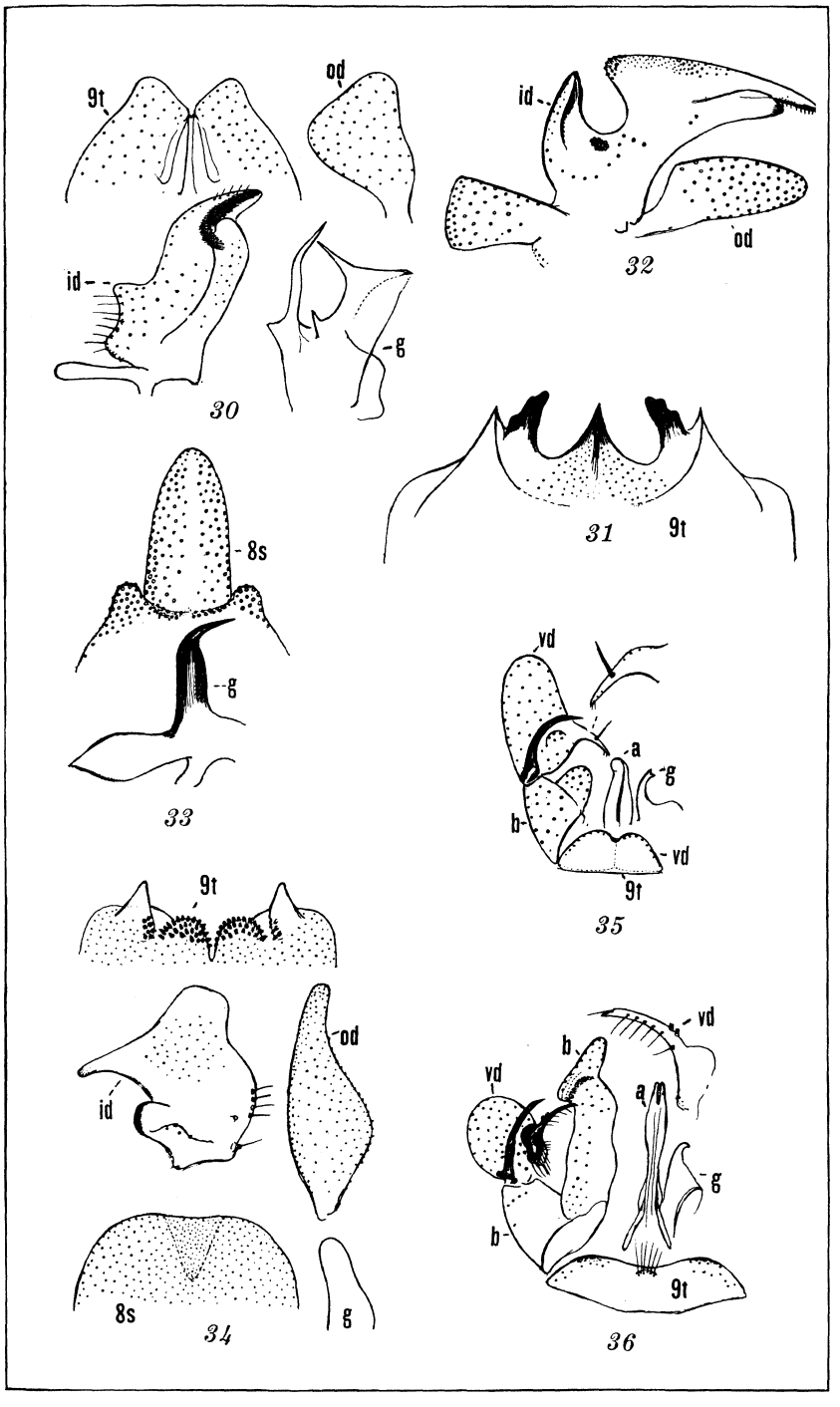
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PLATE 3.

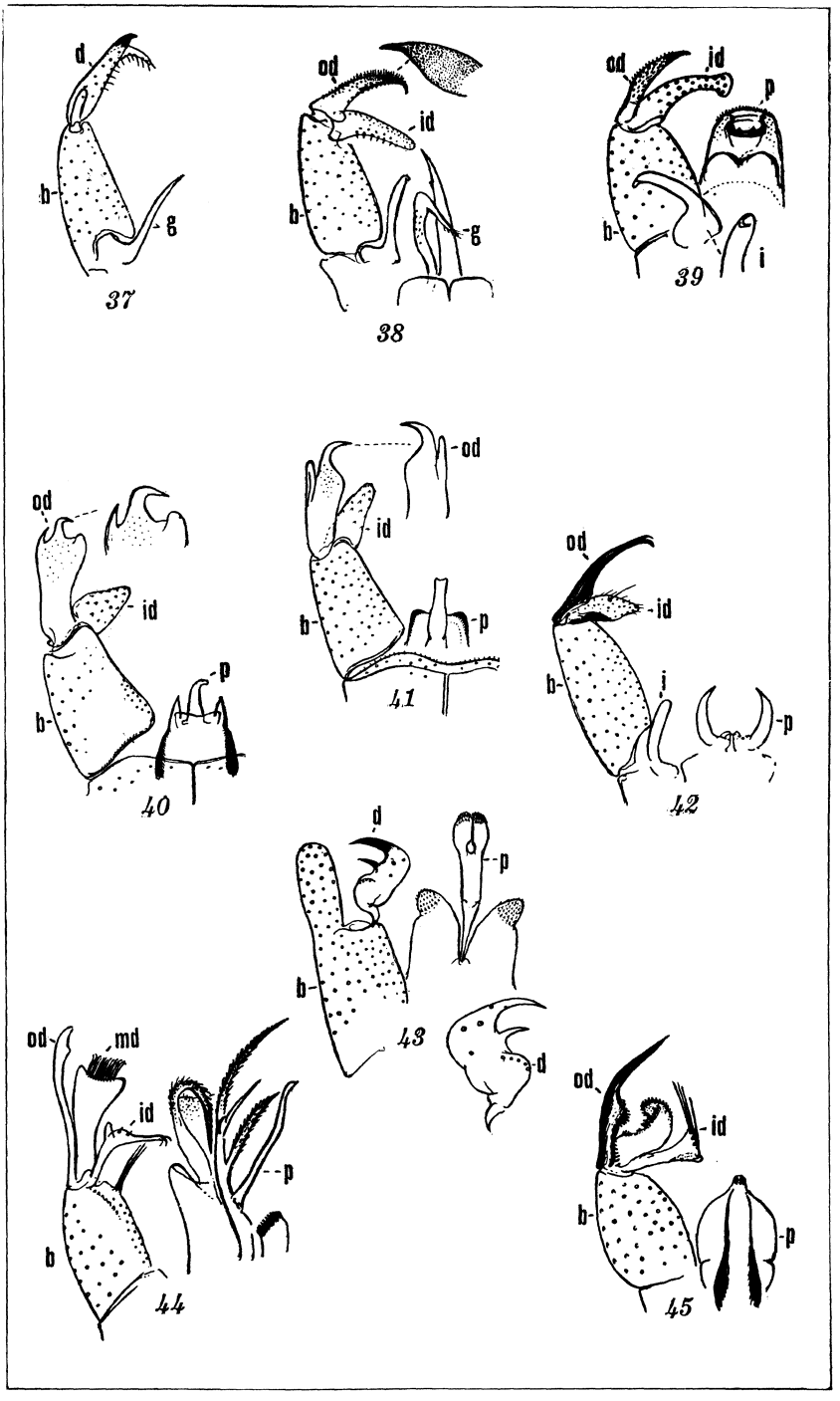
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PLATE 4.

# OCTOCORALLIA FROM PHILIPPINE WATERS

By G. STIASNY

*Curator of Cœlenterates, Rijksmuseum van Natuurlijke Historie Leiden, Netherlands*

TWO PLATES

This paper is based on the study of a collection of Octocorallia from the Philippines, sent me by Dr. Hilario A. Roxas, formerly of the Division of Fisheries, Department of Agriculture and Commerce, and consisting of 12 specimens, classified in the following manner:

Alcyonarians: [1]

## MELITODIDÆ

*Mopsella aurantia* (Esper) 2
*Acabaria formosa* Nutting 2

Gorgonarians:

## PLEXAURIDÆ

*Psammogorgia nodosa* Kükenthal 1
*Plexaura roxasi* sp. nov. 1

## MURICEIDÆ

*Perisceles ceylonensis* (Thoms. & Hend.) 3
*Perisceles fruticosa* Wright & Studer 2

## ACANTHOGORGIIDÆ

*Acanthogorgia dofleini* Kükenthal and Gorzawaky 1

There is one new species, *Plexaura roxasi.* All the other forms, with the exception of *Perisceles ceylonensis,* are new records for the fauna of the Philippines.

Kükenthal (2, p. 809) says that the gorgonarian fauna of the Philippines is extremely poor. He enumerates 18 different species belonging to 15 genera, all of which are represented also, and by a much larger number of species, in the Malayan Archipelago. He, therefore, regards the gorgonarian fauna of Philippine waters as a strongly impoverished Malayan fauna, of which it forms only a part, because it does not contain a single foreign

[1] *See* my new system of Octocorallia (1939).

element. He points out that the families of Suberogorgiidæ, Coralliidæ, and Primnoidæ, so well represented in the Malayan Archipelago, are not represented at all in Philippine waters, and concludes that the Philippine fauna of gorgonarians cannot be regarded as a transitional one to that of Japan.

In my memoir on the gorgonarians from French Indochina (6, p. 357) I said that I did not agree with Kükenthal's opinion that the Philippine fauna of gorgonarians should be such a poor one, that the alleged poverty of this region in Gorgonaria (Holaxonia), while it is so rich in madreporarians and certain alcyonarians (Xeniidæ, Cornulariidæ, Alcyonidæ, Nephthyidæ) is certainly attributable only to inadequate collection, and that on the whole the Octocorallia fauna of the Philippines might not be poorer than the faunæ of the surrounding regions, and might be more or less of the same character.

Already in 1939 I had the opportunity of studying one collection of gorgonarians from the Philippines, belonging to the National Museum in Paris.(8) I discovered that my original opinion was entirely justified. There were found 6 different species (one new) not reported before from this region, representing elements from the Indian Ocean, the Malayan Archipelago, Australia, and Japan.

The present small collection contains, besides a new species, 5 species not hitherto recorded from Philippine waters, but known from India, the Malayan Archipelago, Australia, and Japan, thus presenting the same character as the collection from the Paris Museum. As we see that in each new collection studied there are found new species or new components, one can hardly believe that the gorgonarian fauna of the Philippines is already sufficiently explored. We can, on the contrary, expect with certainty that further exploration will afford further species not yet recorded from these waters, especially species of the family Suberogorgiidæ, represented so abundantly in the neighboring regions. Moreover, while the great depths near the Philippines are inadequately explored with regard to gorgonarians, the known species being almost all littoral forms, in the Malayan Archipelago the great depths have been rather sufficiently explored. Contrary to Kükenthal's opinion, the character of the Philippine gorgonarian fauna cannot be regarded as identical with that of the Malayan Archipelago; but as far as we know at present, it bears the traces of a transitional

fauna between that of the Malayan Archipelago and that of those of the surrounding regions, including Japan.

A complete up-to-date list of all gorgonarians (in the sense of Kükenthal) is much richer than that given by this author in 1919, (2, p. 809) and may be summarized as follows:

*Semperina rubra*
*Solenocaulon tubulosum*
? *Mopsella sinuata*
*Mopsella aurantia*
*Acabaria philippinensis*
*Acabaria formosa*
*Plexaura roxasi*
*Psammogorgia nodosa*
*Psammogorgia perroteti*
*Echinogorgia gracillima*
*Echinogorgia sasappo*
*Echinomuricea philippinensis*
*Muriceides fragilis*
*Perisceles fruticosa*
*Perisceles ceylonensis*
*Brandella inermis*
*Acanthogorgia longiflora*
*Acanthogorgia dofleini*
*Pseudopterogorgia luzonica*
*Junceella squamata*
*Junceella fragilis*
*Ellisella andamanensis*
? *Gorgonella cumingi*
*Gorgonella spinescens*
*Chrysogorgia axillaris*
*Chrysogorgia geniculata*
*Ceratoisis philippinensis*
*Isis reticulata*

There are thus known from Philippine waters at present 29 different species in place of 18 in the list of Kükenthal. All specimens are in a good state of preservation (alcohol).

## Order ALCYONARIA (SCLERAXONIA) Stiasny

### Suborder MELITODACEA Stiasny

### Family MELITODIDÆ Wright and Studer

#### Genus MOPSELLA Gray

**MOPSELLA AURANTIA (Esper).**

For synonyms, *see* Kükenthal. (3, p. 67)

Two specimens, height 130 and 120 mm, without base. More or less densely ramified, with anthocodia expanded.

*Distribution.*—Malayan Archipelago, northwestern Australia. Rather common form. New record from the Philippines.

#### Genus ACABARIA Gray

**ACABARIA FORMOSA Nutting.**

For synonyms, *see* Hickson (1, p. 160) and Kükenthal. (3, p. 77)

Two specimens, 30 and 50 mm long, bifurcated. Cœnenchyma whitish, anthocodia yellow, axis intensely red.

Hitherto known only from Banda Sea.

## Order GORGONARIA (HOLAXONIA) Stiasny

## Family PLEXAURIDÆ

### Genus PSAMMOGORGIA Verrill

**PSAMMOGORGIA NODOSA Kükenthal.**

For synonyms, *see* Kükenthal (3, p. 108) and Stiasny. (5, pp. 39, 42; pl. 1, fig. 4, text fig. L; 6, p. 360)

One specimen, height 240 mm, largest diameter 65, without base. Grayish brownish. This species is reported from New Britain, Banda, Amboina, Madagascar, and Lourenco Marques. New for the fauna of the Philippines.

### Genus PLEXAURA Verrill

**PLEXAURA ROXASI sp. nov. Plate 1; Plate 2, figs. 1 to 9.**

One specimen and numerous small pieces. Height 180 mm, largest diameter 105, without base.

Ramified in one plane, pinnate. Principal branch visible throughout its length, a little thicker than lateral branches, feebly compressed. Lateral branches cylindrical, not thickened at their free ends, not ramified, originating in regular distances in a right angle opposite or alternating, about 100 mm long. Surface of principal branch smooth, with fine longitudinal furrows, that of lateral branches a little rough. Calices on principal branch only on lateral sides, in longer or shorter series, on lateral branches distributed on whole surface in form of low, round verrucæ with feebly developed operculum. Axis strongly calcified, loculated. A circle of thin longitudinal canals around it. Grayish, brownish, yellowish.

Spicules (Plate 2, figs. 1 to 9): Warted knobs (Warzenkeulen) (Plate 2, figs. 1 to 3), transitional forms to foliated knobs (Blattkeulen) (Plate 2, fig. 3), with a few large warts on the swollen part and with a long, poorly-warted stele, 0.096 mm long. Spindles strongly bent, with a few rough warts, on one side much higher than on the other (Plate 2, figs. 4 and 5), 0.09 to 0.12 mm long; sticks bent (Plate 2, fig. 6), or straight (Plate 2, fig. 7), with a few plain warts, other spindles very long, thin, strongly bent, with pointed ends (Plate 2, fig. 8), 0.168 mm long. In anthocodia very small spindles, plane, 0.03 to 0.05 mm long. All spicules transparent. The small pieces are mostly lateral branches, cylindrical, with more or less rough surface, 100 mm long.

This species is related to *Plexaura flava* Nutting from the Malayan Archipelago.[1] Differences: ramified in one plane, principal branch compressed. Lateral branches cylindrical, long. Many strongly bent spindles with warts very much higher on one side than on the other. No knots with spines (Atachelkeulen).

*Diagnosis.*—Ramified in one plane, pinnate. Principal branch compressed with smooth surface. Lateral branches cylindrical, not thickened at their free ends, with rougher surface, originating in regular distances. Opposite or alternating nearly in a right angle, about 100 mm long. Calices in form of low verrucæ with a feebly developed operculum, on principal branch in lateral series, on lateral branches distributed over the entire surface. Axis strongly calcified, loculated, surrounded by a circle of thin longitudinal canals. Spicules: warted knobs (Warzenkeulen) and transitional forms to foliated knobs (Blattkeulen) with a few large warts on the swollen part with a long thin stele poorly warted, about 0.096 mm long; spindles strongly bent, with a few plain warts, warts on one side much higher than on other, 0.09 to 0.12 mm long; sticks straight or bent, with a few plain warts, others strongly bent with pointed ends, about 0.168 mm long. In the operculum very small smooth spindles, 0.03 to 0.05 mm long. All transparent. Grayish, brownish, yellowish.

*Locality.*—Puerto Galera Bay, Mindoro, Philippines.

## Family MURICEIDÆ Verrill

### Genus PERISCELES Wright and Studer

**PERISCELES CEYLONENSIS (Thoms. and Hend.). Plate 2, figs. 10 to 17.**

For synonyms, *see* Kükenthal, (3, p. 193).

Three small specimens 35 to 40 mm high.

This species is recorded from Ceylon, Providence Island, Solomon Islands, mostly from greater depths. I have also indicated this species from the Philippines in my paper on the gorgonarians from the National Museum, Paris. The spicules have not been figured hitherto.

Spicules (Plate 2, figs. 10 to 17): In the cœnenchyma the predominant form is a very large conspicuous type, composed of a foliaceous polyradiate base (Vielstrahler), from which arises

[1] Compare Nutting's description (4, p. 8, pl. 2, fig. 1; pl. 4, fig. 6, a–d) and Stiasny's (5 pp. 55–57, pl. 4, fig. 21, text fig. P).

a spatulated or pointed projection, more or less splintered at the free end (Plate 2, figs. 10 to 12), with large warts in the center of the plate and small warts on the projections, 0.102 to 0.1286 mm long. In the calices S-shaped spindles (Plate 2, fig. 14) or bifurcated spindles (Plate 2, fig. 13), with a few rough warts, 0.12 to 0.16 mm long, others strongly bent with large projections on the concave inner side and small warts in the middle part (Plate 2, figs. 15 and 16), 0.168 mm long. In the tentacles, small sticks forked on one end or with thorns poorly warted, 0.06 mm long. All transparent.

**PERISCELES FRUTICOSA Wright and Studer.**

For synonyms, *see* Kükenthal. (3, p. 196)

Two specimens, with small pieces, 110 mm high, 85 mm broad, without base; 42 mm high, 24 mm broad, base 3 mm broad. This species is known from different localities in the Malayan Archipelago. Recorded for the first time from the Philippines.

## Family ACANTHOGORGIIDÆ Kükenthal and Gorzawaky

### Genus ACANTHOGORGIA Gray

**ACANTHOGORGIA DOFLEINI Kükenthal and Gorzawaky.**

One specimen, 90 mm high, 70 mm broad, without base.

This species is recorded hitherto exclusively from Japan (Sigami Bay).

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# ILLUSTRATIONS

PLATE 1. PLEXAURA ROXASI SP. NOV.

PLATE 2. PLEXAURA ROXASI SP. NOV.

FIGS. 1 to 9. The whole colony, natural size; 10 to 17, *Perisceles ceylonensis*, part of colony; principal branch with smooth surface, lateral branches cylindrical with low verrucæ. On left, lateral branch not thickened at its free end; × 6.

*1*

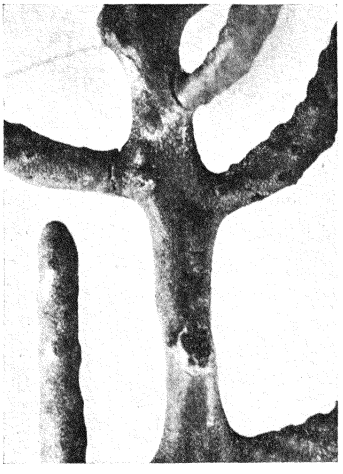

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PLATE 1.

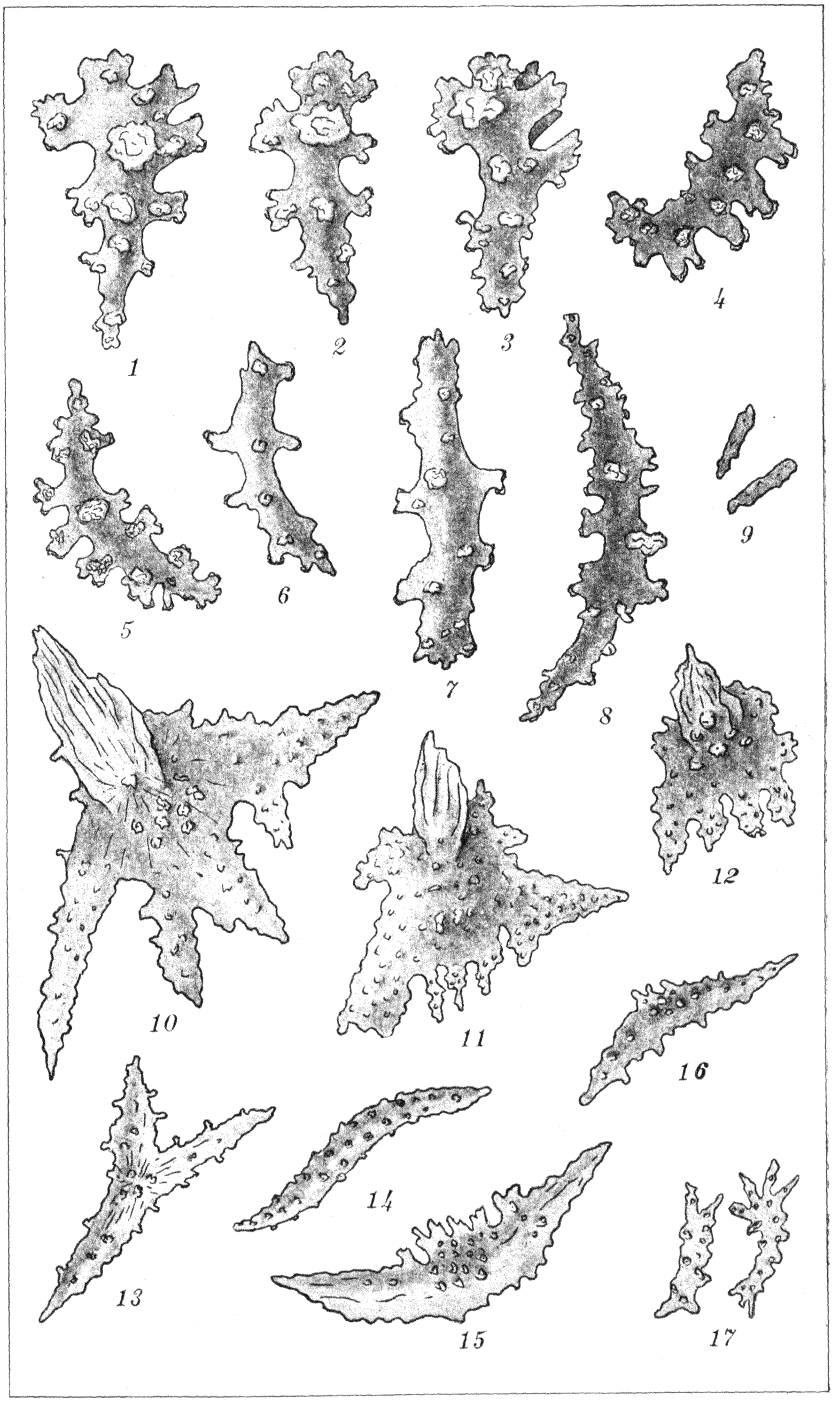


PLATE 2.

# BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

## REVIEWS

Diagnosis and Treatment of Diseases in the Tropics. By H. C. Trowell. London, Bailiére, Tindall and Cox, 1939. 205 pp., illus. Price, 2s /6d.

This book is primarily intended for Africans. It is also designed to give general information about medical and surgical diseases frequently encountered in the Tropics by nurses or orderlies, who have to take the place of doctors under certain conditions. It is easy to understand and recommends itself to those who have little medical education and knowledge of English.—G. F. A.

Chemistry and Medicine. Papers Presented at the Fiftieth Anniversary of the Founding of the Medical School of the University of Minnesota. Edited by Maurice B. Visscher. Minneapolis, The University of Minnesota press, 1940. 296 pp., illus. Price $4.50.

As may be gathered from the foreword, this book is a collection of papers read at the 50th Anniversary of the establishment of the University of Minnesota Medical School. The articles are of interest to physical chemists, nutritionists, immunologists, and neurophysiologists. Each article is an exposé of some subject with which the author is thoroughly conversant, having himself undertaken researches along its line. When an article deals with a controversial topic, the author analyzes existing evidence in favor of or against a given theory in such lucid manner that the reader gets a clear view of the controversy without the necessity of going over numerous papers published on the subject. A case in point is Cannon's article on Chemical Mediation of Nerve Impulses. Between chemagonists and electragonists, there are points of agreement; these are set aside. In points of difference, the facts are presented and discussed from the viewpoint of both chemical and electrical theories. Any one who desires to know the present status of transmission

of nerve impulse across a synapse will find the article interesting reading.—W. P.

The Mixing of Colors and Paints. By F. N. Vanderwalker. Chicago, Frederick J. Drake & Co., 1939. 292 pp., illus. Price, $2.

This book furnishes practical information on the use of colors, paints, and printing inks. Painters, decorators, printers, and others whose professions are intimately related to the proper mixing and blending of colors, will find in this book practical methods which will serve them as a guide to the solution of their daily problems. The principles regarding the most effective use of colors have been reduced to the most simple terms for the layman to comprehend and to put into practical use.

Valuable information on the recent progress and changes made in the composition of various paint materials in the various forms in which they are marketed, as well as standard formulas of ready mixed paints ground in oil, is given. A chapter on printing inks has been included. The author gives a brief history of the essential constituents of printing inks, such as pigments and dyes, oils and varnishes, waxes and ink driers, and the characteristics of ink any ink maker should know. It is, indeed, a very useful book for workers on colors and paints.

—R. H. A.

Vegetable Dyes. By Ethel M. Mairet. New York, Chemical Publishing Co., Inc., 1939. 68 pp. Price $2.

This book contains formulas and other information useful to both the weaver and the dyer. The author gives the characteristics of wool, silk, cotton, and linen, and the different ways of dyeing each with the use of vegetable dyes. It also gives the properties of mordants and other chemicals that are used in dyeing, and the kind of water to be used for the purpose.

This book will be of interest to home dyers, especially in the provinces, who still make use of natural dying materials.

—M. R. A.

Coloring, Finishing and Painting Wood. By Adnah Clifton Newell. Peoria, Illinois, The Manual arts press, 1940. 480 pp., front., illus. Price, $4.50.

The finishing of wood has long been considered an art, and this book not only attempts to encourage its practice as such but also tries to raise it to the level of a science. It discusses exhaustively the different phases of the subject, especially those pertaining to the preparation of wood surfaces for staining, the

different wood stains and their sources, the artificial and natural varnishes, the materials used, and the method of application. It also discusses enamel and lacquer and the method of their application, as well as paints, the sources of materials, and the composition of different coats.

The interesting part of the book is the discussion on the use of synthetic resins for varnish. This new article may eventually replace the natural resins, just as some dyes derived from coal tar have replaced the indigo plant. Another subject of interest is the bleaching of wood. This process is especially useful in attaining uniform surface color in the furniture industry where woods used have variable colors.

The last chapter, devoted to the finishing of metals, is rather out of place under the title of the book, but actually it comes in handy in most woodworking shops, where a certain amount of metal finishing is being done.

The book as a whole is a good reference for any one interested in wood finishing and for foresters.—C. M.

Modern Projects in Woodwork. By J. H. Douglass and R. H. Roberts. Wichita, Kansas, The McCormick-Mathers Publishing Company, 1939. 128 pp., illus. Price, $2.25.

This book is a compilation of woodworking projects intended to be used in vocational high schools in the United States. The projects are more or less graded, starting with the simpler and following up with the more complicated ones as the student becomes more proficient. Each project includes helpful suggestions to the students as well as bills of necessary materials.

Each project is illustrated with drawings with the dimensions of each part given, so that an ordinary carpenter can carry it out without even reading the suggestions. To a student these drawings afford good practice in reading drawings and visualizing projects. He is further aided by photographic illustrations provided in this book. In cutting artistic features, as those having curve lines, the indirect suggestion of making 1- or ½-inch squares on cardboard or on paper and drawing the curve lines on these squares is good.—C. M.

Home Safety. By Priscilla R. Marble. New York, American Book Co., 1940. 144 pp., illus. Price, $0.80.

This book is written for boys and girls, and especially for housewives, whose work is primarily related to the home. It gives a presentation of a home in former days and today, where

safety and comfort are concerned. The first two chapters picture the homes and the mood of living in colonial days. The difficulties of living comfortably and the frequency of accidents during those days are well illustrated. Chapters three to five give the improvements of our modern homes with regard to comfort and safety. Improvements of lighting, heating, and plumbing in the different parts of a home, are well explained. Chapters six and seven give the proper safety measures outside the house, as porch, steps, garage, farmhouse, and farm yard. They also give rules and regulations to insure comfort and prevent calamities. The remaining chapters enumerate the different government agencies which help make a community safe, and the work done by each agency. They also give instructions regarding the application of remedial measures for different disasters that are apt to occur in any home.—V. D. K.

Manual of Mushroom Culture. By G. Raymond Rettew, Otis E. Gahm and Floyd W. Divine. Second Edition. West Chester, Pennsylvania, Chester County mushroom laboratories, 1938. 144 pp., illus. Price, $1.

This publication is intensive as well as comprehensive in its treatment of the art and science of mushroom culture. It covers the following essential aspects: (1) the mushroom industry; (2) mushroom culture; (3) diseases and pests of mushrooms (including their control); (4) technical studies of the mushroom; and (5) mushroom spawn production.

This publication is not only practical but also scientific, the authors—a chemist, an entomologist, and a grower—having made use of their experience and experiments in writing this book.—J. M. M.

A Field Key to Our Common Birds. By Irene T. Rorimer. Cleveland, Ohio, The Cleveland Museum of Natural History, 1940. 160 pp., illus. Price, $1.50.

This book is convenient for field identification of the birds of northeastern United States. It has no direct value to students of Philippine birds, but the presentation of the subject is noteworthy. Although there are objections to the grouping of birds on the basis of habitat, the purpose of the book and the arrangement of the headings justify the style. The illustrations, both halftone and colored, tremendously enhance the value of the book.—C. G. M.

A Dictionary of Scientific Terms. Pronunciation, Derivation, and Definition of Terms in Biology, Botany, Zoology, Anatomy, Cytology, Embryology, Physiology. By I. F. Henderson and W. D. Henderson. Third Edition, Revised by J. H. Kenneth. New York, D. Van Nostrand Co., 1939. 383 pp. Price, $7.

Although it shares the failing common to existing scientific dictionaries of trying to cover too many branches of science and not being sufficiently exhaustive in any of them, "A Dictionary of Scientific Terms" is undoubtedly one of the best of this type of compilations that have appeared so far. The definitions given are brief but adequate, and the derivations, intelligently used, are capable of increasing the usefulness of the book considerably, since they lend themselves to combinations not listed.

The greatest fault of the book lies in the subtitle and its implications. The careful worker in any field of science will be at once struck by the impossibility of including an exhaustive vocabulary on biology, botany, zoology, anatomy, cytology, embryology, and physiology in a book of less than four hundred pages. The only query that prompted me to open this book was the word "interveinicular," spelled so in a manuscript then before me. There are already four or five technical dictionaries at my disposal, which indeed have the more or less common terminologies I am working with, but which invariably fail me in the case of out-of-the-way words that stump me; of course I knew better than to go to them, with "interveinicular," and looked for this word in the book under review. It was not there, nor were any of its variants.

As a compilation of terms used in the biological sciences, the present book ranks with the best of its kind; however, like a dozen books that have preceded it, it does not meet the pressing need of the time for highly specialized vocabularies, exhaustive in their limited fields. It is hoped that this need will in the near future be appreciated and met by compilers as competent as Henderson and Henderson.—S. R.

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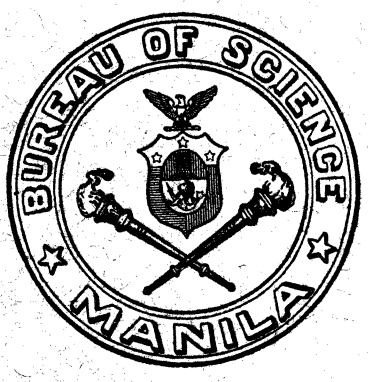
VOL. 76, NO. 1 SEPTEMBER, 1941



# THE PHILIPPINE JOURNAL OF SCIENCE




MANILA
BUREAU OF PRINTING
1941

58000

DEPARTMENT OF AGRICULTURE AND COMMERCE

RAFAEL R. ALUNAN, *Secretary*

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# THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science, Department of Agriculture and Commerce

[Entered at the Post Office at Manila, Philippines, as second-class matter.]

Vol. 76, No.2 October, 1941

Not Available

Destroyed during the war

years

VOL. 76, No. 3 AUGUST, 1944

# THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1944

5994

## THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Institute of Science and Technology
[Formerly Bureau of Science]

[Entered at the Post Office at Manila, Philippines, as second-class matter.]

# EDITOR'S NOTE

The last issue of the Philippine Journal of Science, which was printed before the outbreak of the present war, is Volume 76, No. 2, October, 1941. Because of the present emergency and the circumstances attendant to it, no issues have been printed since then. Henceforth, however, it is intended to publish this Journal, as often as possible, with a view to making available the results of scientific studies and investigations conducted before the present emergency as well as those that are now being undertaken.

This number and the subsequent numbers will be a continuation of those of the last Volume, except for the months of issue, which will be those at the time of printing.

THE PHILIPPINE
JOURNAL OF SCIENCE

VOL. 76 AUGUST, 1944 No. 3

# DISTRIBUTION OF INSULINLIKE PRINCIPLE IN DIFFERENT PLANTS AND ITS THERAPEUTIC APPLICATION TO A FEW CASES OF DIABETES MELLITUS[1]

By FAUSTINO GARCIA

*Of the Institute of Science and Technology, Manila*

THREE TEXT FIGURES

In the first report(1) it was shown that oral administration of the decoction of the old leaves of *Lagerstroemia speciosa*, known by the Tagalog name "banaba," with a dose equivalent to 2 grams per kilogram body weight, produced in normal rabbits starved for 24 hours a fall of blood sugar identical to the effect of subcutaneous injection of a moderate dose of insulin. In the second paper(2) the term insulinlike principle was proposed to designate the active substance, and its distribution and deterioration in different parts of *Lagerstroemia speciosa* were studied. It was shown that the old leaves and ripe fruits contain from 6 to 7.7 units of insulin per 100 cc of 20 per cent decoction, or equivalent to 20 grams of the crude preparations; that mature leaves, young leaves, and flowers have the activity ranging from 4.4 to 5.4 units per 100 cc of 20 per cent decoction; and that the wood does not contain the active principle,

[1] This paper constitutes the third report of a series of pharmacological studies on Philippine medicinal plants that might be used against diabetes mellitus. The greater part of the data presented was obtained while I was connected with the Department of Pharmacology of the College of Medicine, University of the Philippines. Read before the technical staff of the Bureau of Science at its seminar September 30, 1943.

while the bark and roots contain a very small amount. The rate of deterioration for every 20 grams of the dried parts of banaba per week is approximately 0.15 unit for fruits, 0.3 unit for old leaves, 0.58 unit for flowers, 0.6 unit for young leaves, and 0.9 unit for mature leaves.

In the present paper the study of the distribution of insulin-like principle in different plants was carried out, and decoctions made from two plants and a solution of white powder accidentally isolated were tested in cases of diabetes mellitus in the Philippine General Hospital.

## METHOD

The method used in the experimental part is the same as that employed in the second report(2) which has been already published. The only difference is in the use of materials; that is, instead of using the different parts of banaba, different parts of different plants were employed. Generally the leaves were used, but in some cases other parts were tested. The experimental method consists in the use of rabbits once a week and the determination in duplicate of the initial or normal blood sugar of rabbits starved for 20 to 24 hours, by Hagedorn and Jensen's method, using 0.1 cc of blood; then administration of the preparation to be tested and again determination in duplicate of the blood sugar at intervals of one and one-half, three, and five hours. In calculating the equivalent units of insulin, the formula given in the New and Non-Official Remedies(3) for the standardization of insulin was applied. When fresh preparation was employed, the equivalent weight of it when dried was used in the calculation.

With reference to the clinical application, the patients were placed on constant calculated diet and the preparation was given three times a day by mouth in the form of decoction of the part found to contain the greatest amount of active principle or in the form of solution of the powder which was isolated accidentally. Blood sugar and urine sugar were determined at intervals.

## RESULTS

Representative experimental results given as examples of the different trials of a part of the different plants are shown in Table 1. It may be seen in this table that *Syzygium cumini* (duhat), well known and popularly employed by the natives against diabetes mellitus, contains less amount of insulinlike principle than the old leaves or ripe fruits of *Lagerstroemia*

TABLE 1.—*Representative experimental results given as examples of the different trials of a part of different plants in the study of the distribution of insulinlike principle in different plants.*[4]

SYZYGIUM CUMINI (LINN.) SKEELS

| Weight of rabbits. | Parts used. | Initial blood sugar. | Reduction of blood sugar after— | | | Unit per 100 cc of 20 per cent decoction. |
|---|---|---|---|---|---|---|
| | | | 1½ hours. | 3 hours. | 5 hours. | |
| *kg.* | | *mg.* | *mg.* | *mg.* | *mg.* | |
| | Mature leaves per kg. (d)—decoction: | | | | | |
| 1.55 | Fresh, 4 gm.=1.96 dried | 127 | —15 | —18 | —56 | 5.26 |
| 1.55 | One week dried, 2 gm. | 118 | —43 | —10 | —2 | 4.36 |
| 1.55 | Two weeks dried, 2 gm. | 124 | (a) | (a) | (a) | 3.04 |
| | Old bark—decoction: | | | | | |
| 1.55 | Newly taken, 4 gm.=1.68 dried | 127 | —9 | —6 | —34 | 3.54 |
| 1.55 | One week dried, 2 gm. | 111 | —32 | —2 | —4 | 2.86 |
| | Greenish-brown bark—decoction: | | | | | |
| 1.55 | Two weeks dried, 2 gm. | 124 | (b) | (b) | (b) | 4.42 |
| 1.55 | Three weeks dried, 2 gm. | 121 | —5 | —28 | —22 | 3.60 |
| 2.15 | Greenish-brown bark, 1 week dried, 1.5 gm.—infusion | 115 | —9 | —30 | —11 | 4.74 |
| 2.00 | Dried bark, fluid extract, 2 cc. | 110 | —24 | —31 | —25 | 6.14 (per 20 cc) |
| | Duhat seed, extract, 1 cc=24 gm. of dried seed: | | | | | |
| 2.15 | Extract of duhat seed, 1 cc. | | —3 | | | |
| 2.25 | Extract of duhat seed, 2 cc. | | —9 | | | |
| 2.05 | Extract of duhat seed, 3 cc. | | (c) —10 | | | |
| 2.20 | Extract of duhat seed, 5 cc. | | —11 | | | |

[a] Average—16. [b] Average—24. [c] Weak. [d] All doses given are per kg.

TABLE 1.—*Representative experimental results given as examples of the different trials of a part of different plants in the study of the distribution of insulinlike principle in different plants.*[4]—Continued.

LAGERSTROEMIA SPECIOSA (LINN.) PERS.

| Weight of rabbits. | Parts used. | Initial blood sugar | Reduction of blood sugar after— | | | Unit per 100 cc of 20 per cent decoction. |
|---|---|---|---|---|---|---|
| | | | 1½ hours. | 3 hours. | 5 hours. | |
| *kg.* | | *mg.* | *mg.* | *mg.* | *mg.* | |
| 2.15 | Old leaves, 1 week dried, 2 gm. | 87 | —30 | —22 | —13 | 7.70 |
| 1.75 | Ripe fruits, 1 week dried, 2 gm. | 84 | —27 | —19 | —12 | 7.40 |
| | CATHARANTHUS ROSEUS (C.) DON. | | | | | |
| 2.20 | Fresh leaves, 10 gm.=1.8 gm. dried | 102 | —17 | —22 | —10 | 5.72 |
| 2.15 | Leaves, one week dried, 2 gm. | 79 | —21 | +1 | —13 | 4.84 |
| 2.30 | Leaves, one month dried, 2 gm. | 120 | —18 | —23 | —29 | 4.60 |
| | PITHECOLOBIUM DULCE (ROXB.) BENTH. | | | | | |
| 1.50 | Old bark, one week dried, 2 gm. | 115 | —8 | —15 | —28 | 3.92 |
| 1.50 | Greenish-brown bark, one week dried, 2 gm. | 122 | —16 | —27 | —21 | 4.14 |
| 1.60 | Mature leaves, one week dried, 2 gm. | 120 | —16 | —24 | —16 | 3.72 |
| | IPOMOEA BATATAS LINN. | | | | | |
| 1.7 | Fresh tops, 10 gm.=1.9 gm. (pink) | 98 | —29 | —23 | —30 | 7.06 |
| 1.7 | Fresh tops, 10.5 gm.=2 gm. (pink) | 115 | —31 | —25 | —39 | 6.76 |
| 1.6 | Tops, one week dried, 2 gm. (pink) | 103 | —11 | —22 | —15 | 4.12 |
| 1.9 | Fresh mature leaves, 10 gm.=1.2 gm. | 88 | +2 | —3 | +2 | 0.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **IPOMOEA AQUATICA FORSK.** | | | | | |
| 1.65 | Leaves and stems, white, 6 gm.=0.98 gm. | 87 | —4 | —6 | —5 | 3.70 |
| 1.55 | Leaves and stems, pink, 6 gm.=0.98 gm. | 88 | —10 | —16 | 0 | 6.12 |
| | **TAMARINDUS INDICA LINN.** | | | | | |
| 1.60 | Fresh mature leaves, 6.44 gm.=2 gm. dried | 82 | —2 | —14 | —24 | 5.38 |
| 1.65 | Fresh young leaves, 6.44 gm.=2 gm. dried | 86 | —3 | —10 | —20 | 3.38 |
| 1.90 | Mature leaves, one week dried, 2 gm. | 110 | —12 | —1 | —8 | 1.60 |
| | **ANDROPOGON CITRATUS DC.** | | | | | |
| 1.55 | Fresh leaves and stems, decoction, 6 gm.=3 gm. dried | 111 | —7 | —33 | —38 | 4.00 |
| 1.85 | Fresh leaves and stems macerated overnight and then decoction, 4 gm.=2 gm. dried. | 115 | —29 | —36 | —37 | 7.28 |
| | **NYMPHAEA NOUCHALI BURM.** | | | | | |
| 1.55 | Leaves, one week dried, 2 gm. | 92 | —26 | —18 | —24 | 7.20 |
| | **BIOPHYTUM SENSITIVUM (LINN.) DC.** | | | | | |
| 1.50 | Dried roots and stems, 2 gm. | 88 | —29 | —20 | —32 | 9.40 |
| 1.80 | Dried roots and stems, 2 gm. | 117 | —32 | —54 | —40 | 8.74 |

*speciosa* (banaba) which is now used as standard for comparison. The experience of the natives, as stated in my first paper, that "duhat was for sometime considered the best, but at present it is being superseded by banaba," is thus supported by the experimental results. *Catharanthus roseus* (chitchirica) was found slightly stronger than *Syzygium cumini* but still weaker than *Lagerstroemia speciosa.* Mature leaves of *Ipomoea batatas* (camote or sweet potato) contain no insulinlike principle but the tops of the pink variety contain an amount almost equivalent to that in the old leaves of *Lagerstroemia speciosa. Pithecolobium dulce* (kamatchili), *Ipomoea aquatica* (cancong), and *Tamarindus indica* (sampaloc) were found to contain insulinlike principle less than that in the old leaves of *Lagerstroemia speciosa* but almost equal to that in *Syzygium cumini. Andropogon citratus* (paja de meca, sálai), *Nymphaea nouchali* (lawas or water lily), and *Biophytum sensitivum* (makahiyang lalaki) were found to contain insulinlike principle equal to or slightly more than that in *Lagerstroemia speciosa.*

Although the plants tested were few, yet with the varieties I had chosen, those found to contain the greatest amount of insulinlike principle were sufficient to cover the different applications for which this investigation was carried out. For diabetic patients, who wish to avail themselves of the insulinlike principle and at the same time eat the parts containing it, the tops (talbos) of the colored variety of *Ipomoea batatas* (camote) and the shoots of the colored variety of *Ipomoea aquatica* (cancong) are recommended. For making pharmaceutical preparations the following may be used: *Lagerstroemia speciosa, Catharanthus roseus, Syzygium cumini,* and *Biophytum sensitivum.* For the isolation of insulinlike principle, which may require a large amount of material, *Andropogon citratus* (paja de meca, grass) and *Nymphaea nouchali* (waterlily) are recommended, as they are easily obtainable in great quantities.

## CLINICAL APPLICATION

The questions that were asked many times are: Will the preparation of plants found to contain a great amount of insulinlike principle lower the hyperglycemia in diabetes mellitus? What is this active principle? The first question can only be answered by actual tests on diabetic patients. Fortunately, through the coöperation of the doctors of the Philippine General Hospital, clinical tests were conducted to some extent and will be continued especially if good preparation will be made available in the future.

The first case (text fig. 1) was under the service of Dr. Wenceslao Vitug, of the Philippine General Hospital, with Dr. J. C. Cruz as his resident physician. The patient, D. C., was a 55-year old female Filipino, housekeeper, from Malabon, Rizal,

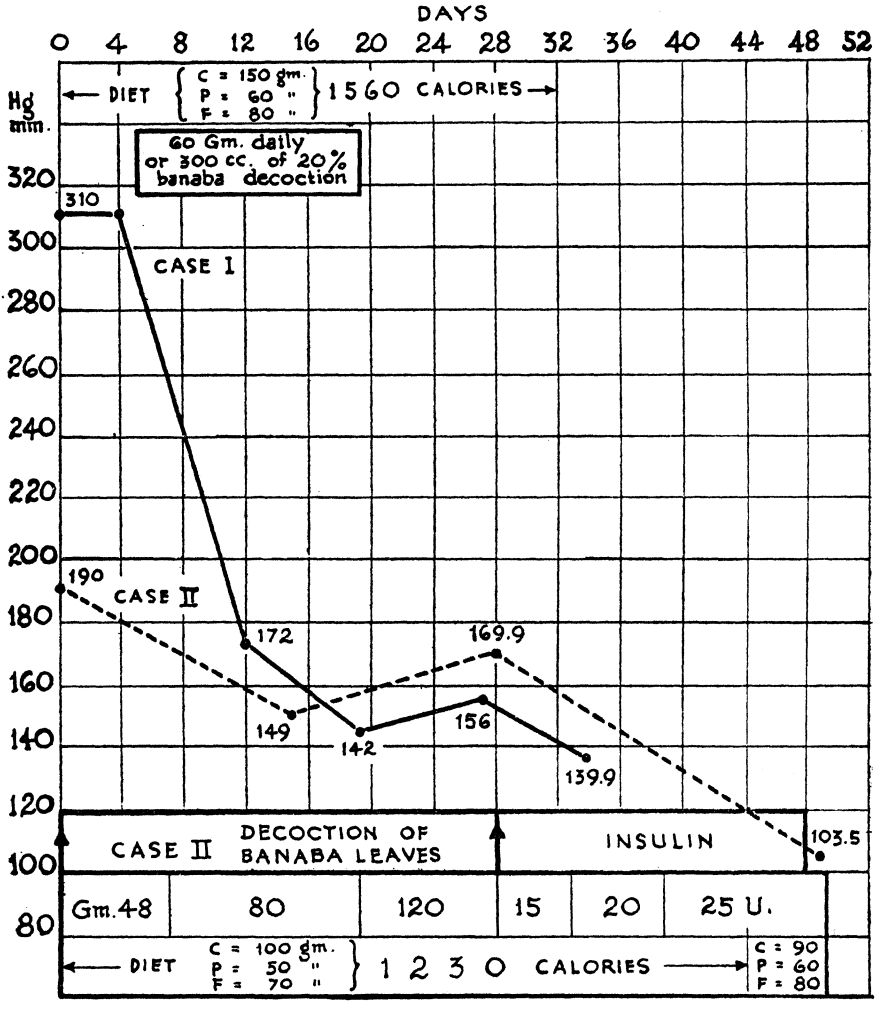


FIG. 1. Chart showing the effects of banaba decoction on Case 1 and Case 2 of diabetes mellitus.

admitted to the hospital on January 2, 1941, for fever, chest pain, and cough. During the first 5 days, she was given full diet, calcium preparations, thiamine, strychnine sulfate, and redoxon. On January 6, 1941, blood sugar determination was requested and the following morning it was reported to be 310 mg. of sugar per 100 cc of blood. At this time her weight was 86.5 lbs. A daily diet of 1,560 calories, consisting of 150

grams carbohydrates, 60 grams proteins, and 80 grams fat, was instituted on January 9, 1941. For five days under this diet the sugar in the urine remained heavy. A decoction of *Lagerstroemia speciosa* was then started on January 14. The dose given of the old leaves was 60 grams daily in the form of 100 cc of 20 per cent decoction three times a day. This dose is equivalent to at least 18 units of insulin daily. Soon after the administration of banaba, the intensity of the reaction of urine by Fehling's test gradually diminished until it became negative 10 days after administration of banaba and remained negative thereafter for the rest of the following two weeks of administration and one week after the administration was stopped. Since then the urine has become sometimes negative or positive to Fehling's test. The blood sugar after 1 week of treatment of banaba was reduced from 310 to 172 mg. and after 2 weeks to 142. When the administration was discontinued the blood sugar rose to 156 mg. a week after, but after a week more with the same diet, it lowered again to 139.9 mg. The patient was discharged, very much improved, one month after the last blood-sugar examination with sometimes negative or positive Fehling's test for sugar in the urine. Unfortunately no blood sugar test had been made before the patient was discharged.

The second case (text fig. 1) was also under the service of Doctor Vitug. The paient, A. F., a 62-year old Spanish mestiza, housekeeper, suffering from diabetes mellitus for six months, was admitted to the hospital for shoulder pain and pricking sensation. On January 9, 1941, she was placed on daily diet of 1,230 calories consisting of 100 grams carbohydrates, 50 grams proteins, and 70 grams fat. Her weight then was 112 lbs. The medicinal treatment during the first three days after her admission consisted of sodium bicarbonate, calcium lactate, Brewer's yeast, and trional. On January 12, 1941, her blood sugar was found to be 190 mg. per 100 cc of blood. Twenty per cent decoction of *Lagerstroemia speciosa* was then started. A daily dose corresponding to 48 grams was given during the first week, and as the urine reaction to Fehling's test remained heavy, the dose was increased to 80 grams daily. At the end of the second week the blood sugar was reduced to 149 mg. The same dose was continued for the third week but, as the urine sugar remained heavy, the dose was increased to 120 grams during the fourth week. Examination of the blood sugar showed a rise to 169.9 mg. in spite of the increased dose. The treatment was

changed to protamine zinc insulin, 15 units for the first 5 days, 20 units for the next 5 days, and 25 units for the last 10 days. The urine sugar was still present in moderate amount even after the administration of 25 units, so the clinician in-charge reduced the diet of carbohydrate by 10 grams. Examination of the blood sugar 5 days after reduction of carbohydrate and continuous administration of protamine zinc insulin for nearly 3 weeks showed a normal amount of 103.5 mg. per 100 cc of blood. The blood-sugar changes in cases I and II are clearly shown in text figs. 1 and 2, respectively.

The preceding two cases taught us a good lesson, for even though there was distinct reduction of blood sugar after the administration of the decoction of *Lagerstroemia speciosa*, this reduction could still be attributed to the calculated diet given. The course of the blood sugar under the given diet, whether going up or down, was not determined. We tried to avoid the mistake in the third and the subsequent cases.

The third case, M.M. (text fig. 2), was also under the service of Doctor Vitug. She was a 30-year old female Filipino, housekeeper, suffering from diabetes mellitus for about 3 years, admitted to the hospital on December 13, 1940, for polyuria and swelling of gums. On December 16, her blood sugar was 188 mg. per 100 cc of blood and her weight was 85 lbs. (39 kg.). Dietetic treatment was instituted on December 18, 19, and 20, 1940, as follows:

| Date. | Carbohydrates. | Proteins. | Fat. | Calories. | Blood sugar. |
|---|---|---|---|---|---|
| December 18, 1940 | 100 | 50 | 50 | =1,050 | 188 |
| December 19, 1940 | 110 | 60 | 60 | =1,220 | |
| December 20, 1940 | 130 | 60 | 60 | =1,300 | |

As the urine sugar increased, the diet was gradually reduced, as follows:

| Date. | Carbohydrates. | Proteins. | Fat. | Calories. | Blood sugar. |
|---|---|---|---|---|---|
| December 21, 1940 | 110 | 50 | 50 | =1,090 | |
| December 24, 1940 | 100 | 50 | 50 | =1,050 | |
| December 26, 1940 | 90 | 50 | 50 | =1,010 | |
| January 1, 1941 | | | | | 126 |
| January 14, 1941 | | | | | 158.7 |
| January 16, 1941 | 80 | 50 | 50 | = 970 | |

The diet was to be further reduced, but upon my request it was raised for the purpose of experimentation, as follows:

| Date. | Carbohydrates. | Proteins. | Fat. | Calories. | Blood sugar. |
|---|---|---|---|---|---|
| January 21, 1941 | 100 | 50 | 60 | =1,140 | |
| January 23, 1941 | 110 | 50 | 60 | =1,220 | |
| January 27, 1941 | 120 | 70 | 70 | =1,390 | |
| February 5, 1941 | 140 | 80 | 70 | =1,510 | |
| February 14, 1941 | 140 | 80 | 70 | =1,510 | 196.1 |

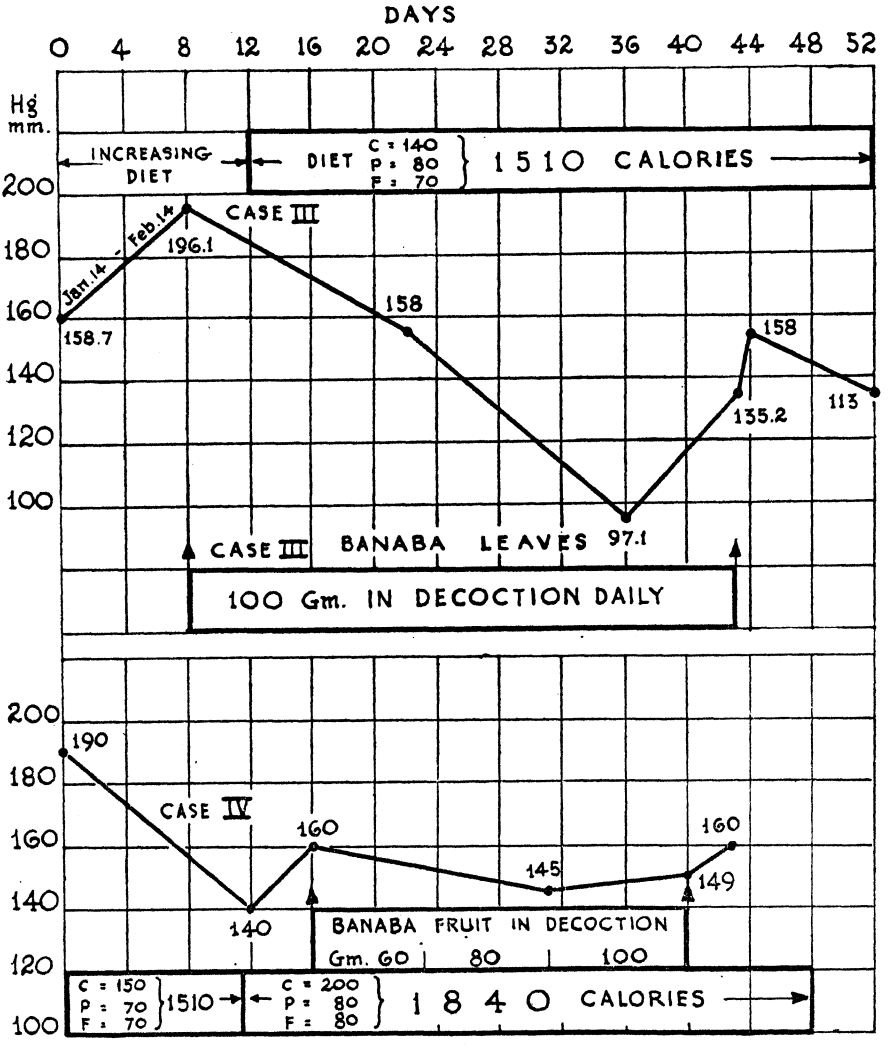


FIG. 2. Chart showing the effects of banaba decoction on Case 3 and Case 4 of diabetes mellitus.

Banaba treatment consisting of 100 cc of 20 per cent decoction 3 times a day was instituted on February 14 until March 17, and the results are as follows: On February 14, blood sugar was 196.1; on February 28, 158; on March 12, 97.1; and on March 17, 135.2. One day after suspension of banaba decoction the blood sugar was 158.0, and on March 26, it was 113.0.

As may be seen in the foregoing treatment, the increase of diet to 1,510 calories caused the blood sugar to rise to 196.1 mg. per 100 cc of blood, which was more than that when she entered. The course of blood sugar in this case is shown in text fig. 2. The effect of banaba treatment was very distinct during the four weeks of treatment. It reduced the blood sugar to normal, 97.1 mg. per 100 cc of blood after three weeks of treatment, but when the treatment was continued for another week and the blood examined at the end of the treatment, the blood sugar was found to have slightly risen to 135.2 mg. After suspension of the treatment for 1 day the blood sugar rose to 158 mg. However, a week after the treatment was stopped, it returned to normal, 113 mg. per 100 cc of blood.

The fourth case, also shown in text fig. 2, was an instance in which a high diet was intentionally given to see if the administration of the decoction of banaba will prevent the rise of blood sugar. This case, a messenger of the Philippine General Hospital, male Filipino, 36 years old, married, was admitted to the hospital on November 3, 1942, for the relief of general body weakness, dimness of vision and polyuria. He was placed under the service of Dr. Regino Navarro, with Drs. Ignacio and Silva assisting. On November 6, 1942, his blood sugar was 190 mg. per 100 cc of blood and his weight was 52.3 kg. A daily diet consisting of 150 grams carbohydrates, 70 grams proteins, and 70 grams fat of a calculated calories of 1,510 was instituted on November 7, 1943. After twelve days under this diet the blood sugar went down to 140 mg. At my request the diet was gradually increased to 1,675 calories on November 21, and then to 1,800 calories on November 23, consisting of 200 grams carbohydrates, 80 grams proteins, and 80 grams fat. The sugar output in the urine greatly increased and the blood sugar on November 27 rose to 160 mg. after 4 days under the latter diet. Decoction of ripe banaba fruits was instituted with the following dosage: 60 grams for the first week, 80 grams for the second week, and 100 grams for the third week. After the second week the blood sugar was 145 mg. and ten days later it was 149 mg. Suspending the decoction and examining the blood sugar

3 days after showed an increase to 160 mg. The diet given was almost of the same amount that he used to take when at work as messenger. When he was discharged, he was taught the method of preparing the decoction, and since then he has been seen at intervals, strong, stout, and with negative or slight sugar in the urine.

The fifth case, text fig. 3, is an illustration of the effect of insulinlike principle obtained from other plants. This case, R. F., was a 37-year old male American, prisoner of war, single, engineer, referred to the hospital from San Lazaro Hospital on September 9, 1942, for glycosuria and furuncolosis. Blood sugar on admission was 410 mg. per 100 cc of blood and his weight was 64.2 kg. On September 11 he was placed on diet consisting of 100 grams carbohydrates, 50 grams proteins, and 60 grams fat, with a calculated value of 1,140 calories. For six days under this diet his blood sugar rose to 540 mg. Insulin was subcutaneously injected, 10 units twice daily for about a week and 20 units twice daily for another week. Blood sugar examination on September 22, 1942, or six days after the insulin injection, showed a blood sugar of 440 mg., and 410 mg. on October 5, and 390 mg. on October 17, 1942. On November 4, 1942, his blood sugar was 440 mg. He was then placed on decoction of 300 gm. daily of the fresh tops of *Ipomoea batatas* (talbos ñg camote) which is equivalent to 60 gm. of dried tops. His diet was increased to 1,600 calories, consisting of 150 grams carbohydrates, 70 grams proteins, and 80 grams fat. After 3 weeks of treatment his blood sugar went down to 330 mg. One week after stopping the treatment the blood sugar rose to 400 mg. Placed on the white powder solution of 0.5 per cent from duhat, giving 5 cc by mouth twice a day for 5 days and then 5 cc three times a day for 7 days, equivalent to 5 and 7.5 centigrams daily, the patient's blood sugar went down to 338 mg.

There were other cases, outside patients, that were tried, with reduction or disappearance of glycosuria, but, as the observation on blood sugar was lacking, they were not included in this paper. In this connection some explanation about the white powder from *Syzygium cumini* (duhat) would serve as a partial answer to the second question. This powder was accidentally isolated during the process of alcoholic extraction of duhat bark by Dr. Josefina Ramos, of the College of Pharmacy. It was noticed that some powder floated on the alcoholic extract and that this was gathered by her laboratory helper, although in small amount, and labeled by somebody as "extract of duhat."

Unfortunately that somebody could not be identified when I tried to find out more information about the powder. Doctor Ramos believed it to be only mineral that separated during the extraction. However, when I tested the hypoglycemic effect I was surprised to find its effectiveness in lowering blood sugar by oral administration and by subcutaneous injection. The data of the experimental findings are given in Table 2. As shown in this table, 1 cc of 0.5 per cent solution, or 5 mg. of the powder,

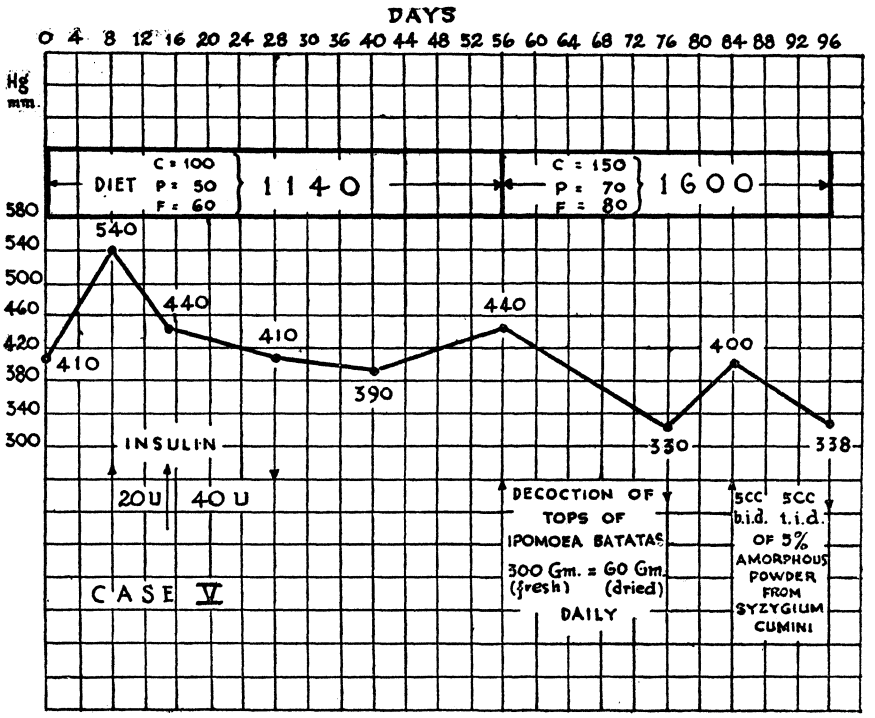


FIG. 3. Chart showing the effects of decoction of tops of *Ipomoea batatas* and the solution of powder from *Syzygium cumini* on Case 5 of diabetes mellitus.

is equivalent to at least 2.2 units. Based upon this unitage, the dose given to the fifth patient ranged from at least 22 to 33 units daily with the amount given of 10 to 15 cc. of 0.5 per cent solution. The powder readily dissolved in solution with the addition of a small amount of dilute acid and the solution did not produce any of the characteristic reactions of alkaloid, glucoside, and tannin. It was light brownish-white amorphous powder, odorless and slightly bitter. One gram of this powder has a value of 440 units of insulin when administered orally and twice this strength when injected subcutaneously.

TABLE 2.—*Equivalent insulin units of white powder from Syzygium cumini as determined by its hypoglycemic effect in rabbits.*

| Weight of rabbits. | Preparations employed and dosage. | Initial blood sugar. | Reduction of blood sugar after— | | | Unit per cc of 0.5 per cent solution. |
|---|---|---|---|---|---|---|
| | | | 1½ hours. | 3 hours. | 5 hours. | |
| *kg.* | Subcutaneous injections of: | *mg.* | *mg.* | *mg.* | *mg.* | |
| 1.80 | 0.05 cc x kg. of 0.5 per cent solution of crystal powder | 109 | —4 | —6 | —16 | 4.03 |
| 1.75 | 0.2 cc x kg. of 0.5 per cent solution of crystal powder | 89 | —21 | —28 | —26 | 4.26 |
| | Oral administration of: | | | | | |
| 1.60 | 0.4 cc x kg. of 0.5 per cent solution | 91 | —24 | —31 | —28 | 2.20 |
| 1.75 | 0.2 cc x kg. of 0.5 per cent solution | 98 | —19 | —26 | —25 | 3.20 |
| 1.60 | 0.2 cc x kg. of 3 weeks old 0.5 per cent solution | 84 | —2 | —3 | —21 | 1.65 |

As additional support to the statement that the active principle can be isolated in the form of powder, I refer to the work of Miss Lourdes Ocampo who, under the advice of Dr. A. C. Santos, isolated a small amount of white powder from 5 kg. of old banaba leaves. When I injected a very small amount of it intravenously in a dog, a marked fall of blood sugar was produced. Because of the limited amount of the powder she had isolated, additional tests could not be performed.

## DISCUSSION

The insulinlike principle is distributed in the different plants tested. The parts of the plant containing the greatest amount are not definite, for, while in *Lagerstroemia speciosa* the bark was found to contain small amount as published in my second paper, in the case of *Syzygium cumini* the same part (bark) was found to contain relatively moderate or sufficient amount. In many plants the mature leaves were found to contain moderate amount and less in the young, but in the case of *Ipomoea batatas* the mature leaves were found to have none, while the young or tops contained a great amount. Deterioration of the insulinlike principle on keeping was observed in that found in different plants just as it occurred in the different parts of *Lagerstroemia speciosa* as shown in my second report.(2) The first four cases of diabetes mellitus treated with decoction of the old leaves or ripe fruits of *Lagerstroemia speciosa* showed that blood sugar can be reduced after two to four weeks of treatment. In the first two cases the reduction can be attributed to diet, but in the third and fourth cases this factor was eliminated, for there was evidence that the tendency with the given diet before treatment was towards a rise. In the fourth case, where liberal diet was given, the decoction did not only stop the rise but even reduced the blood sugar. In the fifth case decoction of the tops of *Ipomoea batatas* distinctly reduced the blood sugar, and the white powder from *Syzygium cumini* with a daily dose of from 5 to 7.5 centigrams administered orally, also distinctly reduced the blood sugar. In all cases, soon after suspension of the decoction, the blood sugar rose, but after sometimes the blood sugar lowered again even if the decoction was not given. The rise was to be expected, but the subsequent fall of blood sugar would need some explanation. It is possible that suspension of the insulinlike principle which causes a rise of blood sugar might have stimulated the pancreas that might have partially recovered after having been given rest during the treat-

ment, to function more actively thus lowering the blood sugar from the preliminary rise immediately after suspension of the decoction.

## SUMMARY AND CONCLUSION

1. The different plants examined were found to contain insulinlike principle in some parts of each in greatest amount.

2. For diabetic persons who wish to avail themselves of the insulinlike principle and at the same time eat the parts containing it, the "talbos ñg camote," or the tops of the colored variety of *Ipomoea batatas*, and the shoots of "cancong," or *Ipomoea aquatica*, are recommended.

3. For making pharmaceutical preparations the following which contain sufficient amount of insulinlike principle are available: *Lagerstroemia speciosa*, *Catharanthus roseus*, *Syzygium cumini*, and *Biophytum sensitivum*.

4. For isolating the insulinlike principle, *Andropogon citratus* and *Nymphaea nouchali* are recommended, for they are easily obtainable in great quantities.

5. In the four well-observed clinical cases, where decoction of *Lagerstroemia speciosa* was administered orally, the blood sugar reduction to about normal occurred in all cases. The factor of diet in lowering blood sugar was completely eliminated in the third and fourth cases.

6. In the fifth case the decoction of tops of *Ipomoea batatas* administered for three weeks lowered the blood sugar from 440 to 330 mg. per 100 cc of blood.

7. In the case of the white powder isolated from *Syzygium cumini*, the blood sugar was reduced from 400 to 338 mg. per 100 cc of blood by daily administration of 5 centigrams for 5 days, and 7.5 centigrams for 7 days, which are equivalent to at least 22 and 33 units of insulin daily, respectively.

8. The decoction is not a suitable preparation for a prolonged use, as the administration of 20 units would require a large volume, such as 100 cc three times a day of 20 per cent. Thus it would be desirable that some concentrated pharmaceutical preparation or solution or other preparation of the isolated principle be made in the future.

9. The insulinlike principle can be isolated in powder form as was already shown by the accidental separation of the amorphous powder in a small amount during the process of extraction of *Syzygium cumini* bark and the small amount of white powder obtained from the extraction of several kilos of the old leaves

of *Lagerstroemia speciosa* which also possesses a high hypoglycemic property.

10. The powder accidentally isolated does not possess alkaloidal, glucosidal, and tannin properties. It is a light brownish-white amorphous powder, odorless and slightly bitter. One gram of it has a value of 440 units of insulin when administered orally and twice that strength when administered subcutaneously.

ACKNOWLEDGMENT

I wish to extend my thanks and appreciation to Dr. Wilfrido de Leon, of the Institute of Hygiene, whose scientific interest has enabled me to carry out this investigation by lending two rabbits every week for experimental use; to Dr. A. G. Sison, Director of the Philippine General Hospital; to Dr. Luis Guerrero, Chief, Department of Medicine; to Drs. Vitug and Navarro and their associates under whose services the clinical tests were made feasible; and to Dr. Eduardo Quisumbing for helping me in getting the modern names of the plants that were tested.

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# ILLUSTRATIONS

# SOME PHILIPPINE CLAYS AS POSSIBLE BLEACHING AGENT FOR LOCAL VEGETABLE OILS

By AURELIO O. CRUZ

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Different types of clay have been used in medicine from time immemorial either as external or internal remedies. According to Remington [1] and others, the value of these remedies appears to reside in their absorbing properties, although there are some who attribute to them direct antiseptic action. The variety commonly known as Fuller's earth has a much higher absorbing power than kaolin. Because of its property of absorbing large amounts of liquid, Fuller's earth is used for many pharmaceutical purposes, especially in the preparation of pills. Not only, however, will it mechanically hold considerable liquid, but further has the property of separating many dissolved substances from solutions. To what this absorbing power is due, is at present somewhat obscure, although it appears to be in part dependent upon the colloidal nature of the earth. Kingzett [2] attributes this absorbing action of Fuller's earth, to the combination of mechanical and electrical properties, the active constituents being probably hydrated silica and hydrated alumina.

Other investigators [3] have found out that no definite relationship exists between the absorptive powers and the chemical compositions of clays.

Fuller's earth is extensively used in the mineral and vegetable oil industries as a clarifying and bleaching agent. The Philippines, from 1934 to 1938, imported annually about a million and a half kilos of Fuller's earth valued at 23,000 pesos. The greater portion, if not all of this earth, is used in bleaching refined coconut oil for edible purposes.

If a cheap bleaching agent could be found from local materials, then even our commercial coconut oil whose color reading

[1] The Dispensatory of the United States of America ed. 20 (1918) 605.
[2] Chem. Encyclopoedia (1932) 377.
[3] Natural and Applied Science Bull. 5 (1936) 159.

usually runs as high as 6.6 Red and 39 Yellow could be bleached. Dark-colored oils, which are valued very low at present, could be bleached to the desired lightness in color. The coconut oil exported is valued according to the degree of coloring and the percentage of free fatty acids it contains.

The clays are either used in their natural state or are sometimes especially treated in order to increase their bleaching efficiency.

The two essential points that should be remembered in the use of clays for the oil industry are (1) bleaching efficiency or removal of the coloring matter from the oil, and (2) minimum loss of oil due to absorption.

This investigation was therefore undertaken with the idea of testing some Philippine clays as possible bleaching agent for coconut oil and other vegetable oils and comparing the results with those obtained by using imported Fuller's earth.

## EXPERIMENTAL PROCEDURE

The samples of clay used in this investigation were named after the place of origin. Sample a was taken from Rosario, Pasig, Rizal; b, from Pansol, Laguna; c, from Siruma, Camarines Norte; d, from the Ceramic Industries of the Philippines at Balintawak, Caloocan, Rizal; e, collected by the former Division of Soil Survey, from Buenavista Estate; and f, submitted by a certain Mr. Hubbard, who gave the information that the said sample had been taken from a deposit in the former U. S. Reservation in Bataan Province.

In the preparation of the clays for the test, each sample as received was first dried in the oven and then powdered to pass through a 100-mesh sieve. It was again placed in the oven heated at 105°C. until free of moisture. This powdered dry clay was labeled as the natural sample.

The treated sample was obtained by taking a portion of the powdered clay (natural) and boiling it with 5 per cent dilute hydrochloric acid for about thirty minutes. For every gram sample, 10 cubic centimeters of the diluted acid were used. The mixture was then allowed to settle and the product washed by decantation until free of acid. The washed clay was then dried, ground, and passed through the 100-mesh sieve.

The bleaching efficiency of the clays was determined according to the Bleach Test as described by Jamieson,[4] using, however,

[4] Jamieson, G. S., Vegetable Fats and Oils (1932) 398.

different percentages of earth. Three hundred grams of the oil were weighed into a pyrex beaker 4 inches in diameter and 5½ inches deep with about 1,000 cubic centimeters capacity. This oil was heated to 120°C. and the required amount of clay added. It was stirred at 250 r. p. m. (±5) for 5 minutes, not allowing the temperature to fall below 105° C., and then filtered through filter paper. After sufficient oil has filtered to insure clearness, a sample was collected and the color determined according to the method adopted by the Coconut Oil Manufacturers of the Philippines (1924). The oil used in all the tests is a commercial grade coconut oil of a color reading of 4.2 Red and 27.0 Yellow. The results of the bleaching test are recorded in Table 1.

TABLE 1.—*Color readings of coconut oil bleached with different percentages of Philippine clays and imported Fuller's earth.*

| Clays. | Percentages of bleaching agent used. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2 | | 4 | | 6 | | 8 | |
| | Red. | Yellow. | Red. | Yellow. | Red. | Yellow. | Red. | Yellow. |
| Philippine— | | | | | | | | |
| a. Rosario: | | | | | | | | |
| 1. Natural | 3.7 | 21.0 | 2.3 | 15.0 | 2.0 | 12.0 | 1.9 | 9.0 |
| 2. Treated | 2.0 | 12.0 | 1.2 | 9.0 | 1.1 | 9.0 | 1.1 | 9.0 |
| b. Pansol: | | | | | | | | |
| 1. Natural | 2.2 | 15.0 | 1.8 | 9.0 | 1.3 | 9.0 | 1.3 | 9.0 |
| 2. Treated | 3.1 | 21.0 | 2.0 | 12.0 | 1.9 | 9.0 | 1.4 | 9.0 |
| c. Siruma: | | | | | | | | |
| 1. Natural | ------ | -------- | ------ | -------- | 5.2 | 33.0 | ------ | -------- |
| 2. Treated | ------ | -------- | ------ | -------- | 5.0 | 30.0 | ------ | -------- |
| d. Balintawak: | | | | | | | | |
| 1. Natural | 3.1 | 21.0 | 2.1 | 15.0 | 1.7 | 9.0 | 1.3 | 9.0 |
| 2. Treated | 2.2 | 15.0 | 1.6 | 9.0 | 1.1 | 9.0 | 1.1 | 9.0 |
| e. Buenavista: | | | | | | | | |
| 1. Natural | 2.9 | 15.0 | 1.9 | 9.0 | 1.5 | 9.0 | 1.1 | 9.0 |
| 2. Treated | 2.9 | 15.0 | 2.1 | 15.0 | 1.9 | 9.0 | 1.9 | 9.0 |
| f. Bataan: | | | | | | | | |
| 1. Natural | 2.1 | 15.0 | 1.5 | 9.0 | 1.0 | 6.0 | 1.0 | 6.0 |
| 2. Treated | 2.0 | 12.0 | 1.2 | 9.0 | 1.0 | 6.0 | 1.0 | 6.0 |
| Imported— | | | | | | | | |
| a. Fuller's earth 1 | 2.0 | 12.0 | 1.1 | 9.0 | 1.1 | 9.0 | 1.0 | 6.0 |
| b. Fuller's earth 2 | 1.5 | 9.0 | 1.0 | 6.0 | 1.0 | 6.0 | 1.0 | 6 |

As shown by the data Rosario and Balintawak clays have better bleaching properties when specially treated than when they are used in their natural state. These treated samples have about the same decolorizing efficiency as the imported

Fuller's earth 1, though lower than that of Fuller's earth 2. There was a slight improvement in the Bataan clay when treated; Siruma increased the color of the oil instead of bleaching it. On the other hand samples from Pansol and Buenavista gave better results when used in their natural state than when treated.

In determining the loss of oil due to absorption, the procedure for the Bleach Test was followed but modified in that the filtration was done by means of a Buchner funnel as suggested by Richert.[5] When the clay seemed to be dry, vacuum being kept up for 15 minutes, it was removed from the funnel and weighed. The amount of clay used in this test was 6 per cent. In Table 2 are given the results on the absorption of oil by some Philippine clays and two samples of imported earth for comparison.

TABLE 2.—*Absorption of oil by some Philippine clays and two samples of imported Fuller's earth.*

| Bleaching agent used. | Bleaching agent plus oil. | Oil absorbed. |
|---|---|---|
| Philippine Clays— | | |
| a. Rosario: | *Grams.* | *Per cent.* |
| 1. Natural | 21.9728 | 22.07 |
| 2. Treated | 23.6030 | 31.12 |
| b. Pansol: | | |
| 1. Natural | 29.6172 | 64.54 |
| 2. Treated | 29.0930 | 61.62 |
| c. Siruma | | |
| d. Balintawak: | | |
| 1. Natural | 22.6058 | 25.58 |
| 2. Treated | 23.7110 | 31.72 |
| e. Buenavista: | | |
| 1. Natural | 18.7734 | 12.89 |
| 2. Treated | 19.1570 | 19.28 |
| f. Bataan: | | |
| 1. Natural | 27.4670 | 52.60 |
| 2. Treated | 27.0165 | 50.10 |
| Imported— | | |
| a. Fuller's earth 1 | 32.2632 | 79.24 |
| b. Fuller's earth 2 | 24.9058 | 38.36 |

As shown by the data, Rosario, Balintawak, and Buenavista clays absorbed less oil than the imported earth, Buenavista giving the lowest percentage of oil absorbed. Pansol and Bataan clays gave lower percentage loss of oil than the imported earth 1, but higher than that of earth 2.

[5] Journ. Ind. Eng. Chem. 9 (1917) 599.

## SUMMARY AND CONCLUSION

The results from the six samples tested show that the Philippine clays differ in their bleaching efficiency, with the exception of Siruma, which increased the color of the original oil. When specially treated, Rosario and Balintawak clays gave about the same bleaching efficiency as imported Fuller's earth 1, although lower than that of earth 2. However, the two local clays have the advantage in that the loss of oil due to absorption is lower as compared with the imported earth. In the Buenavista clay, both the natural and the treated samples have less amount of oil absorbed, but not so efficient for bleaching purposes. Clays from Pansol and Bataan are the best among the local samples for decolorizing purposes as no special treatment is necessary.

From the foregoing results, it is evident that there are a number of clays found in the Philippines that can be used for clarifying and bleaching purposes in place of the imported Fuller's earth for the local vegetable oil industry.

# GLAZING PHILIPPINE POTTERY WARE

By G. O. OPIANA

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Deposits of clays have been found in various localities in the Philippines and some investigations [1] have been carried out to ascertain the characteristics of these clays.

Reports [2] have also been made on the native methods for manufacturing ceramic ware. These products consist of articles such as flower pots, vases, bricks, vats, water jugs, and tinajas. Those sold in and around Manila are made mostly by the potteries of San Pedro Makati, Rizal Province. In some of these potteries glazed flower pots of various sizes, shapes and colors, ranging from bluish green to reddish brown, are made. Because of the secrecy exercised in making the glazes and of the fact that the Philippine potters have not developed this art, this line of ceramics is completely in the hands of foreigners, mostly Chinese.

This paper reports some experiments made on the glazing of San Pedro Makati pottery ware. Both raw ware and biscuits were used in this study.

## RAW WARE AND BISCUITS

The raw ware is generally made as follows:

Red clay from the town of Rosario, Rizal Province, is loaded in bancas and carried to San Pedro Makati where it is piled near a pit which is about 4 meters deep and from 1 to 1.3 meters in diameter. The clay is dropped into the pit until about a quarter of it is filled. River water is added in small portions until the pit is nearly full. The mixture is stirred continuously,

[1] Cox, A. J., Philip. Journ. Sci. § A 2 (1907) 413.
Ibid. § A 3 (1908) 377.
Adams, C. I., and W. E. Pratt, Ibid. § A 5 (1910) 143.
Witt, J. C., Ibid. § A 11 (1916) 203.

[2] Witt, J. C., Philip. Journ. Sci. § A 8 (1918) 59.
Christie, E. B., Ibid. § D 9 (1914) 117.
Crowe, C. H., Trans. Amer. Cer. Soc. 14 (1912) 723.

using wooden stirrers, or paddles, so as to suspend and disintegrate the clay. The liquid is discharged to another pit of similar size and shape by pouring through a sieve of about 25 mesh, using petroleum cans for the purpose. Water is again added to further dilute the mixture and the stirring is continued. The clayey liquid is finally discharged into an open rectangular plot (about 5 by 8 meters) which is floored with broken ware. The wide surface facilitates evaporation of most of the water. The semisolid material is collected and deposited under a nearby shed to age. To prevent excessive evaporation, the pile is covered with wet sacks.

A portion of the material is pugged by treading with the feet and, when thoroughly mixed, it is ready for making the ware either with or without the use of molds on the potter's wheel. The finished ware is dried inside the shed for more than a week and is then ready for biscuit firing. Unburned air-dried ware is called raw ware and the fired ware is known as biscuits. Only the biscuits are used for glazing.

## ANALYSES AND TESTS

The analyses and tests made on a representative sample of local pottery clay are given in the following tables. Only standard methods, with slight modifications, were used.

TABLE 1.—*Analysis of Philippine pottery clay.*[a]

| Constituent. | Per cent. |
|---|---|
| Silica ($SiO_2$) | 50.06 |
| Alumina ($Al_2O_3$) | 19.16 |
| Iron oxide ($Fe_2O_3$) | 8.54 |
| Lime (CaO) | 2.23 |
| Magnesia (MgO) | 2.42 |
| Potash ($K_2O$) | 0.81 |
| Soda ($Na_2O$) | 2.25 |
| Loss on ignition | 13.95 |

[a] Analysis made by Mr. Jose Roco, of the Division of Tests and Standards, Bureau of Science.

TABLE 2.—*Rational analysis of Philippine pottery clay.*[a]

| Constituent. | Per cent. |
|---|---|
| Kaolinite | 26.76 |
| Orthoclase | 4.78 |
| Albite | 19.03 |
| Anorthite | 11.06 |
| Free silica | 18.74 |
| Limonite | 9.50 |
| Magnesium carbonate | 5.06 |
| Water at 100° C. | 7.38 |

[a] The results are calculated from the chemical analysis.

Table 1 shows the chemical analysis and Table 2 the rational analysis of the clay. The latter was calculated by following the method of Washington [3] as used by Ries.[4] An examination of Table 2 shows that the sum of the percentages of orthoclase, albite, and anorthite (total feldspar) is 34.87. This large amount accounts for the low fusing point of the clay.

TABLE 3.—*Physical tests of Philippine pottery clay.*

| | |
|---|---|
| Water of plasticity (per cent) | 34.66 |
| Volume shrinkage (per cent) | 52.62 |
| Linear shrinkage [a] (per cent) | 22.03 |
| Tensile strength [b] | ([d]) |
| Transverse strength [b] | 270.0 |
| Slaking time (min.) | 80 |
| Drying qualities (room temperature) | good |
| Approximate fusing point (°C.) | 1,180 |
| Moisture [c] (per cent) | 5.67 |

[a] Calculated from volume shrinkage.
[b] Pounds per square inch.
[c] Material sieved through 20 mesh.
[d] The test pieces cracked in the testing machine.

The physical tests are given in Table 3. The tensile strength is nil which suggests the careful handling of the raw ware. The transverse strength is 270 pounds. Although the shrinkage is quite high, yet the drying qualities at room temperature are good. Because of the low fusing point, only lead glazes can be employed in using this clay.

TABLE 4.—*Mechanical analysis of Philippine pottery clay.*

| Constituent. | Per cent. |
|---|---|
| Clay substance | 55.66 |
| Silt | 10.81 |
| Dust sand | 8.85 |
| Fine sand | 24.91 |
| Coarse sand | 0.16 |

Table 4 gives the mechanical analysis of the sample. Although the percentage of clay is high, there is a considerable amount of silt, dust sand, and fine sand. The presence of these impurities makes the clay somewhat porous. This condition helps in the rapid evaporation of the water, thus confirming the good drying qualities at room temperature.

[3] Amer. Cer. Soc. 1 (1918) 405.
[4] Clays, their occurrence, properties and uses. John Wiley and Sons, Inc., New York (1927).

## PREPARATION, APPLICATION AND FIRING OF GLAZES

To prepare a glaze for the biscuit, which was prepared from the clay, the chemical composition of the latter should be determined. Following the method of Seger,[5] the molecular composition of the clay may be calculated from the percentage composition by dividing the percentage of each constituent by the corresponding molecular weight. The results obtained are given in Table 5.

TABLE 5.—*Molecular composition of pottery clay.*

| Constituent. | Percentage composition. [a] | Molecular weight. | Molecular composition. |
|---|---|---|---|
| Silica ($SiO_2$) | 58.2 | 60 | 0.970 |
| Alumina ($Al_2O_3$) | 22.3 | 103 | 0.216 |
| Iron oxide ($Fe_2O_3$) | 9.9 | 160 | 0.062 |
| Lime (CaO) | 2.6 | 56 | 0.046 |
| Magnesia (MgO) | 2.8 | 40 | 0.070 |
| Potash ($K_2O$) | 0.94 | 94 | 0.010 |
| Soda ($Na_2O$) | 2.6 | 62 | 0.042 |

[a] Calculated from the chemical analysis.

For convenience, the sum of the percentages of the fluxes CaO, MgO, $K_2O$ and $Na_2O$ may be represented by the symbol RO; and the sum of the percentages of $Al_2O_3$ and $Fe_2O_3$ may be designated by the symbol $R_2O_3$. Accordingly, the molecular formula of the clay may be stated as follows:

$$(RO)\ (1.65\ R_2O_3)\ (5.77\ SiO_2)$$

Based on the above formula, the molecular formula for the glaze may be calculated as follows:

$$(0.2\ RO + 0.8\ PbO)\ (0.33\ R_2O_3)\ (1.154\ SiO_2)$$

An examination of the formula above shows that the ratio of total RO to $SiO_2$ is 1:0.58, considering that 3RO is equivalent to 1 $R_2O_3$. Glasses have a ratio of 1RO: 2.5 $SiO_2$ with practically no $Al_2O_3$. Glazes containing lead have a ratio as low as 1:1.17 with about 0.1 mole of $Al_2O_3$. In this study the ratio which gave the best results was from 1:1.27 to 1:1.37. The corrected formula is given below:

$$(0.2\ RO + 0.8\ PbO)\ (0.33\ R_2O_3)\ (2.53\ SiO_2)$$

[5] Collected Writings 2 (1902) 1114.

Rice-hull ash which contained from 94 to 96 per cent $SiO_2$ was added to correct the deficiency in silica. The weights of the ingredients are as follows:

| | Grams. |
|---|---|
| Grog | 8.0 |
| Clay | 4.08 |
| Red lead | 18.30 |
| Rice-hull ash | 8.6 |

The same clay, fired at about 750° C., and powdered to pass 100 mesh, is called the grog. The grog was added to correct the tendency of the glaze to rise as the temperature increases.

The mixture was ground wet to a paste on a ground glass. After diluting with water to a paint consistency, it was applied with a brush on a slightly wetted biscuit. The biscuit which was dried in air and then in an oven was finally fired in an electric muffle. A red shiny glaze that matured between 920° and 980°C., was obtained. Long crazes developed on cooling.

The formula was further corrected and the following was finally adopted:

$$(0.25\ RO + 0.75\ PbO)\ (0.41\ R_2O_3)\ (3.04\ SiO_2)$$

The weights of the ingredients are as follows:

| | Grams. |
|---|---|
| Grog | 10.0 |
| Clay | 5.2 |
| Rice-hull ash | 10.1 |
| Red lead | 17.2 |

The above glaze matured between 920° and 980° C., giving a reddish-brown glaze on the Rosario clay biscuit. It was observed, however, that the glaze did not give uniform results when prepared in larger quantities because of the tendency of red lead to settle at the bottom. This defect was corrected by fritting part of the materials. The frit consisted of the following:

| | Grams. |
|---|---|
| Grog | 20.0 |
| Red lead | 34.4 |
| Rice-hull ash | 20.2 |

For the final compounding of the glaze there was added raw clay amounting to 0.52 gram for every 3.63 grams of frit used. The mixture was finally powdered wet in a ball mill. The glaze obtained was uniform.

By using the preceding formula a clear fritted overglaze was also developed using Pansol clay. The chemical analysis of this clay is shown in Table 6.

TABLE 6.—*Analysis of Philippine Pansol clay.*[a]

| Constituent. | Per cent. |
|---|---|
| Silica ($SiO_2$) | 49.62 |
| Alumina ($Al_2O_3$) | 31.68 |
| Iron oxide ($Fe_2O_3$) | 1.29 |
| Lime (CaO) | 0.86 |
| Magnesia (MgO) | 0.33 |
| Potash ($K_2O$) | 0.38 |
| Soda ($Na_2O$) | 0.34 |
| Loss on ignition | 14.68 |

[a] Analysis made by Mr. Jose Roco, of the Division of Tests and Standards, Bureau of Science.

Following the method used in calculating the molecular formula for the pottery clay, we obtained the following formula for the Pansol clay:

$$(RO)\ (10.25\ R_2O_3)\ (27\ SiO_2).$$

Using lime as part of RO, we deduce the following glaze formula:

$$(0.02\ RO + 0.18\ CaO + 0.80\ PbO)\ (0.2\ R_2O_3)\ (0.54\ SiO_2)$$

In order to make the ratio 1:1.30, like the pottery glaze, it was necessary to make a correction. The corrected formula follows: $(0.02\ RO + 0.18\ CaO + 0.80\ PbO)\ (0.2\ R_2O_3)\ (2.08\ SiO_2)$. As it was found that the glaze was not very fusible, addition of $0.2\ B_2O_3$ was made. The glaze matured between 900° and 950°C. with short crazes. Further corrections gave the following final formula:

$$(0.02\ RO + 0.18\ CaO + 0.80\ PbO)\ (0.2\ R_2O_3)\ (2.08\ SiO_2 + 0.2\ B_2O_3)$$

In preparing the above glaze, fritting was necessary. The frit was composed of the following:

| | Grams. |
|---|---|
| Grog | 7.2 |
| Lime carbonate | 3.6 |
| White lead | 41.4 |
| Rice-hull ash | 19.4 |
| Boric acid | 5.0 |

For the final compounding of the glaze, 0.18 gram of clay was added for every 3.41 grams of frit.

The use of flint bottles in the compounding of glaze was tried. Generally, a flint bottle (ordinary white glass) has a molecular

of (RO) (2.5 $SiO_2$). The analysis of this bottle is shown in Table 7.

TABLE 7.—*Analysis of a flint (clean glass) bottle.*[a]

| Constituent. | Per cent. |
|---|---|
| Alumina ($Al_2O_3$) | 0.53 |
| Lime (CaO) | 6.37 |
| Magnesia (MgO) | 2.83 |
| Soda ($Na_2O$) | 17.80 |
| Silica ($SiO_2$) by difference | 72.47 |

[a] Lagenbeck, K. The chemistry of pottery. Chemical Publishing Co., Easton, Pa. (1895).

The alumina in the glass is considered an impurity. The molecular formula of the glass was calculated in the same way as the clay molecular formula, as shown below:

$$(0.61\ Na_2O + 0.24\ CaO + 0.15\ MgO)\ (2.56\ SiO_2)$$

As previously mentioned, alumina is a necessary ingredient in glazes. In pottery glazes, it amounts usually to 0.2 mole. The following is the mixture that matured between 920° and 980° C. after a series of trials:

| | Grams. |
|---|---|
| Flint glass | 10.50 |
| Rice-hull ash | 6.10 |
| Red lead | 11.20 |
| Pansol clay | 5.20 |

The molecular formula of the above mixture is:

$$(0.5\ RO + 0.5\ PbO)\ (0.2\ Al_2O_3)\ (2.56\ SiO_2)$$

In this formula, the 0.5 RO consists of the following:

$$\tfrac{1}{2}\ [(0.61\ Na_2O + 0.24\ CaO + 0.15\ MgO)\ (2.56\ SiO_2)]$$

The fired ware was reddish brown and had short crazes.

In the production of other colored wares, the use of colored engobes was tried. Such engobes consist of a watery mixture of clay and inorganic coloring matter. After repeated trials, the mixture adopted was composed of 90 per cent grog and 10 per cent clay, both from Pansol. Gum acacia, amounting to 2 per cent of the mixture, was used as a sticker. A paint consistency of this mixture was prepared with the addition of metallic colors like $Fe_2O_3$, $Cr_2O_3$, and CoO. The colored engobes were painted on the raw ware with no deleterious effect. After air and oven drying, they were biscuited in the electric muffle at around 750° to 800° C. When this colored biscuit was overglazed, there was produced a beautiful glaze-colored ware.

SUMMARY

The chemical and mechanical analyses and physical tests were made on the Rosario pottery clay as used in the San Pedro Makati district.

A glaze, made from the San Pedro Makati clay, was developed for the biscuit, with the use of the same clay with addition of rice-hull ash and red lead.

There was also developed an overglaze composed of Pansol clay, lime carbonate, white lead, rice-hull ash and boric acid.

From ordinary flint (white) bottles a glaze was made by the addition of Pansol clay, rice-hull ash, and red lead.

Rice-hull ash is a good source of silica in glazing local pottery ware.

The use of colored engobes for producing colored ware, using Pansol clay, was satisfactory.

# NEW OR INTERESTING PHILIPPINE PLANTS, II

By EDUARDO QUISUMBING

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The present paper, like the preceding one, is largely composed of the descriptions of fifteen apparently undescribed species in various families which have been worked out from time to time during the past few years.[1] Two species previously described by various authors from extra-Philippine material are here recorded from the Archipelago for the first time. Following the rules of priority some nomenclatural changes are included. Unless otherwise indicated in the text, the types of the new species are deposited in the Philippine National Herbarium.

## JUGLANDACEÆ

### Genus ENGELHARDTIA Leschenault

**ENGELHARDTIA SERRATA Blume.**

*Engelhardtia serrata* BLUME, Fl. Jav. Juglandeae 2 (1826–36) 14, *t. 4 et 5c;* MIQ., Fl. Ind. Bat. 1[1] (1856) 843; C. DC. Prodr. 16[2] (1864) 141; HOOK F., Fl. Brit. Ind. 5 (1890) 596; KOORD. ET VALET., Bijdr. Booms. Java 5 (1900) 172, Atlas Baumarten Java 4 (1918) *f. 699;* KOORD. Excursionsfl. Java 2 (1912) 53, *f. 7.*

*Engelhardtia palembanica* MIQ., Fl. Ind. Bat. Suppl. (1861) 346.

MINDANAO, Surigao Province, Placer, *Wenzel 3015* (female plant), *3015a* (male plant), *3006* (male plant), August, 1927. A species not previously reported from the Philippines, Java, Penang, and probably in Borneo and Celebes. With the exception of the leaves, which are pubescent on both surfaces, the slender peduncles and the stigmas of the specimens cited closely match Blume's figure and description. The two stigmas are often bifid.

## MORACEÆ

### Genus FICUS Linnæus

**FICUS DELTOIDEA Jack.**

*Ficus deltoidea* JACK, Malay Misc. 7 (1822) 71.

*Ficus ovoidea* JACK, Malay Misc. 7 (1822) 71.

[1] Philip. Journ. Sci. 41 (1930) 315–371.

*Ficus diversifolia* BLUME, Bijdr. (1825) 456; MIQ., Fl. Ind. Bot. 1[2] (1859) 328; HOOK. F., Fl. Brit. Ind. 5 (1888) 529; WINKLER in Engl. Bot. Jahrb. 49 (1913) 365; RIDLEY, Fl. Malay Penin. 3 (1924) 346; MERR., Journ. Royal As. Soc. Straits Branch Spec. No. (1921) 222; MIQ., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 269, 289; CORNER, Wayside Trees of Malaya 1 (1940) 687.

*Ficus diversifolia* BLUME var. *lutescens* (Desf.) KING in Ann. Bot. Gard. Calcutta 1 (1887) 140; WINKLER in Engl. Bot. Jahrb. 49 (1913) 365; MERR., Journ. Royal Soc. Straits Branch, Spec. No. (1921) 223.

*Ficus spathulata* MIQ. in Hook. London Journ. Bot. 7 (1848) 441.

*Ficus sideroxifolia* GRIFF., Not. 4 (1854) 389, Ic. Pl. As. 4 (1854) *t. 551, f. 2.*

*Ficus lutescens* DESF., Cat. Hort. Par. ed. 3 (1829) 413.

*Synoecia diversifolia* MIQ. in Hook. Journ. Bot. 7 (1848) 470, *t. 9B.*

*Erythrogyne frutescens* VISIANI in Gaspar Ricerch. Caprif. Fic. (1845) 86; MIQ. in Hook. London Journ. Bot. 7 (1848) 453.

Apparently of the bush type, glabrous. Leaves 1.5 to 7.5 centimeters long, 0.7 to 5.2 centimeters wide, deltoid or cuneate-obovate, the apex broadly truncate to rounded, narrowed to the acute base, chartaceous, rusty-olive beneath, midrib forked, with a dark-brown bland at the fork of the midrib beneath; petiole 0.5 to 1.5 centimeters long. Fruit solitary or in pairs, axillary, rounded, 4 to 8 millimeters in diameter; peduncle 7 to 10 millimeters long.

PALAWAN, Tiglaplan River, *Bur. Sci. 77650 Edaño*, April 24, 1929, on forested slopes, altitude about 450 meters; *Bur. Sci. 77482 Edaño*, April 15, 1929, altitude about 1,700 meters. Very common in Borneo, Sumatra, Malay Peninsula, etc.

The species is new to the Philippines, but for it I accept Jack's specific name which is three years older than Blume's, and there is no doubt as to the identity of Blume's species with that described by Jack. It is characterized by its deltoid or cuneate-obovate, blunt leaves which are rusty-olive beneath and the presence of a conspicuous gland at the fork of the midrib. Corner (l. c.) reports that the plant is exceedingly variable in leaf-form, the seedlings and some varieties of full-grown plants having pointed leaves. Corner further states that the mountain form has smaller fruits while the seashore form has larger fruits; this is true also with the Philippine specimens, our mountain form has much smaller fruits (4 to 5 millimeters in diameter). In habit the plant is also variable, generally an epiphyte but occurring also as a terrestrial bush on sandy shores and on mountain tops and in bogs.

## ANONACEÆ

### Genus GONIOTHALAMUS Blume

**GONIOTHALAMUS CATANDUANENSIS Quis. sp. nov.**

Arbuscula 2–4 m alta floribus exceptis glabra; foliis oblongis, rarissime oblongo-oblanceolatis, 28–38.5 cm longis, 11–18.5 cm latis, basi subacutis vel acutis, apice brevissime abrupte acuminatis; nervis lateralibus utrinque 14–18, subtus prominentibus, anastomosantibus; inflorescentiis trunci- vel rami-floris; floribus solitariis vel fasciculatis, pedicellatis; sepalis 3, triangulari-ovatis, acutis, 4–7 mm longis, extus sparse pubescentibus; petalis exterioribus ovato-lanceolatis, acuminatis, 2.5–3.5 cm longis, 1.4–2 cm latis, pubescentibus; petalis interioribus ovatis, acutis, 8–9.5 mm longis; densissime pubescentibus; staminibus numerosis, 2–2.5 mm longis; carpellis numerosis, 4–4.5 mm longis, cylindraceis, stylis simplicibus, ad basi pubescentibus et curvatis; fructibus oblongis, 1.7–2.3 cm longis, 1.3–1.4 cm diametro, glabris.

A shrub 2 to 4 m high, glabrous throughout except the flowers; trunk terete, dark brown; branches terete, slender, brownish gray when dry. Leaves large, oblong, very rarely oblong-oblanceolate, 28 to 38.5 cm long, 11 to 18.5 cm wide, subcoriaceous, the base subacute or acute, the apex shortly and abruptly acuminate; lateral nerves 14 to 18 on each side of the midrib, prominent beneath, anastomosing, the reticulations somewhat prominent; petioles 1.5 to 2.5 cm long. Flowers white (Ramos & Edaño), from tubercles of the slender trunk and branches, solitary or fascicled, their pedicels slender, 1.3 to 1.5 cm long. Sepals 3, valvate, lobes ovate, acute, 4 to 7 mm long, sparsely pubescent. Petals 6, the outer three ovate-lanceolate, 2.5 to 3.5 cm long, 1.4 to 2 cm wide, acuminate, pubescent; the three inner cohering over the stamens and carpels, ovate, acute, 8 to 9.5 mm long, densely pubescent on the outside. Stamens numerous, 2 to 2.5 mm long, the connectives elongated; carpels numerous, 4 to 4.5 mm long, cylindric, the style simple, but the base curved and pubescent. Fruits oblong, 1.6 to 2.3 cm long, 1.3 to 1.4 cm in diameter, dark brown, glabrous; the peduncles 2 to 2.5 cm long, slender.

CATANDUANES, Albay Province, Simamla, *Bur. Sci. 75183 Ramos & Edaño* (type), August 8, 1928, at low altitudes; Dukulangpatag, *Bur. Sci. 75590 Ramos & Edaño*, August 20, 1928, along forested streams, altitude about 700 m. LUZON, Camarines Sur Province, Mt. Potianai, *Bur. Sci. 75937 Edaño*, November 5, 1928, on forested slopes, altitude about 900 m;

Agosais, *Bur. Sci. 76135 Edaño,* October 24, 1928, along streams in forests, altitude about 500 m.

A species in vegetative characters, particularly in its large leaves, somewhat resembling *G. gigantifolius* Merr. and *G. suluensis* Merr., but differing radically in its floral details and fructification. It differs from *G. suluensis* Merr. in having smaller leaves and flowers and in the details of its floral parts; and from *G. gigantifolius* Merr. radically in the shape and size of the fruits, and in its leaves having fewer lateral nerves.

### Genus DREPANANTHUS Maingay

**DREPANANTHUS CONVOCARII Quis. sp. nov.**

Arbor circiter 7 m alta fructibus exceptis glabra; foliis oblongis, 33–42 cm longis, 13.5–19.5 cm latis, basi acutis, apice abrupte breviter acuminatis; nervis lateralibus utrinque 14–15; fructibus ellipsoideis, 1–1.9 cm longis, 1–1.2 cm diametro, glabris.

A small tree about 7 m high, pubescent throughout except the mature fruits; branches dark brown, rusty pubescent. Leaves large, oblong, 33 to 42 cm long, 13.5 to 19.5 cm wide, subcoriaceous, the base acute, the apex shortly acuminate; lateral nerves 14 to 15 on each side of the midrib, prominent; the young leaves very densely pubescent on both surfaces, becoming glabrous on the upper surface in the mature leaves; petioles densely pubescent, 2 to 2.8 cm long. Flowers unknown. Fruits many, ellipsoid, borne on branches, 1 to 1.9 cm long, 1 to 1.2 cm in diameter, glabrous, black.

MINDANAO, Agusan Province, Asiga River, *Bur. Sci. 84112 Ramos & Convocar,* April 23, 1931, in damp forests, altitude about 1,000 m.

*D. Convocarii* is apparently somewhat allied to *D. apoensis* Elm., from which it is readily distinguished by its larger, oblong leaves. This species is named in honor of Mr. Pascual Convocar, a collector of the Philippine National Herbarium.

## LAURACEÆ

### Genus CINNAMOMUM Blume

**CINNAMOMUM OROI Quis. sp. nov.**

Arbor circiter 15 m alta, ramulis et subtus foliis et inflorescentiis dense molliter griseo-pubescentibus; foliis coriaceis, oblongo-ellipticis, ad 12.5 cm longis, et 5.5 cm latis, supra nitidis, apice acutis, basi acutis, valde 3-plinerviis; paniculis terminalibus, laxifloris, 12–18 cm longis; floribus pedicellatis, circiter 3 mm longis; staminibus 2–2.25 mm longis, filamentis quam

antheris duplo longioribus, pubescentibus; staminoidiis stipitatis, 1.4–1.5 mm longis, pubescentibus; ovario glabro, obovoideo.

A tree about 15 m high (Oro); branches, lower surfaces of the leaves, and the inflorescence densely and softly gray-pubescent. Leaves opposite or subopposite, coriaceous, oblong-elliptic, 10 to 12.5 cm long, 3 to 5.5 cm wide, apex acute, base acute, the upper surface very smooth and shining, the lower dull, prominently 3-plinerved; petioles 8 to 12 mm long, densely pubescent when young, in age glabrescent. Panicles in the upper axils, laxly flowered, 12 to 18 cm long, densely and softly gray-pubescent. Buds obovoid. Flowers about 3 mm long, externally densely pubescent, the pedicels very slender; the perianth lobes oblong-obovate, obtuse. Stamens 2 to 2.25 mm long, the filaments pubescent, about twice as long as the anthers. Staminodes stipitate, 1.4 to 1.5 mm long, pubescent. Ovary glabrous, obovoid; the style as long as the ovary.

LUZON, Tayabas Province, Kagascas, *For. Bur. 30880 Oro*, April 1, 1929, on forested slopes, altitude about 300 m.

In vegetative characters approaching those of *C. Sandkuhlii* Merr. differing, however, in having smaller leaves, shorter inflorescences, more slender peduncles, smaller flowers and obovoid ovaries. Further, *C. Sandkuhlii* is a high altitude form, while this species is a low altitude one. The species is named in honor of Mr. M. Oro, forester and an active collector of the Philippine Bureau of Forestry.

### Genus LITSEA Lamarck

**LITSEA DIOSPYRIFOLIA Quis. sp. nov.**

Arbor glabra, 5-8 m alta; ramulis, petiolis et nervis in sicco nigrescentibus; foliis alternis, oblongis, vel oblongo-ellipticis, coriaceis, ad 10.6 cm longis, et 6.2 cm latis, basi acutis vel subacutis, apice obtusis vel rarissime rotundatis, supra nitidis, nervis utrinque 7 vel 8, reticulis gracilibus, obscuris; fructibus nigrescentibus, globosis, glabris, 1.3-1.5 cm diametro, calycibus accrescentibus, hypocrateriformibus, circiter 1 cm diametro.

A glabrous tree, 5 to 8 m high (Edaño). Branches terete, grayish brown to brown; the branchlets distinctly black when dry. Leaves alternate, oblong to oblong-elliptic, coriaceous, 6 to 10.6 cm long, 3 to 6.2 cm wide, narrowed to the acute or subacute base, apex obtuse or very rarely rounded, olivaceous-brown to dark brown and shining on the upper surface, the lower surface paler and somewhat glaucous; lateral nerves 7 or 8 on each side of the midrib, prominently dark brown to black, the reticulations slender, obscure; petioles slender, black, 1.5 to

3 cm long. Fruits usually three developing from each very short peduncle, black, glabrous, globose, 1.3 to 1.5 cm in diameter, the accrescent calyx salver-shaped, the tube subcylindric, stout, 5 to 6 mm long, the limb spreading, about 1 cm in diameter.

LUZON, Camarines Sur Province; Her-it River, *Bur. Sci. 76459 Edaño* (type), December 8, 1928, on forested slopes, altitude about 800 m; Mt. Isarog, *Bur. Sci. 76232 Edaño*, November 28, 1928, on forested slopes, altitude 1,300 m.

The leaf is unique in form and coloring, and without the fruits one might mistake it for a *Diospyros*. It is characterized by its small, oblong to oblong-elliptic, glabrous leaves and large, black, globose, glabrous fruits.

## BURSERACEÆ

### Genus HEMISANTIRIA H. J. Lam

The genus *Hemisantiria* was proposed by Lam in 1929 for certain species of *Santiria* and *Canarium* which do not properly belong to these two genera.

According to Lam, *Hemisantiria* is a genus between *Canarium* and *Santiria;* although with rather vague limits. He thinks its separation necessary to contain some twelve or thirteen species, most of which were formerly placed in *Canarium* but which are distinctly different from the type of that genus in the characters of the leaves, flowers, and especially the fruits. From *Santiria* it may be distinguished by the ovoid, not or hardly zygomorphous fruits, the nearly apical style, and the nearly always unisexual flowers.

Below is given the only Philippine species described under *Santiria,* which is referable to *Hemisantiria.*

**HEMISANTIRIA NITIDA (Merr.) H. J. Lam.**

*Hemisantiria nitida* (Merr.) H. J. LAM in Merr. Univ. California Publ. Bot. 15 (1929) 118.

*Santiria nitida* MERR. in Govt. Lab. Publ. (Philip.) 35 (1905) 29, Philip. Journ. Sci. 1 (1906) Suppl. 71, Enum. Philip. Fl. Pl. 2 (1923) 356.

## EUPHORBIACEÆ

### Genus CLAOXYLON Jussieu

**CLAOXYLON PUBESCENS Quis. sp. nov.**

Frutex 1-2 m altus; ramulis, foliis infructescentiisque dense pubescentibus; foliis viridibus, ellipticis vel lanceolato-ellipticis, chartaceis ad 20 cm longis, et 8 cm latis, basi acutis vel subacutis, apice abrupte acuminatis, nervis utrinque 5 vel 6, margine

minute glanduloso-denticulatis vel dentatis; petiolis ad 10.5 cm longis; flores ♂ et ♀ ignoti; infructescentiis brevibus, ad 4 cm longis; capsula subglobosa, densissime pubescente, 1.2–1.5 cm diametro, 3-loculari; seminibus globosis, glabris, rugosis, 4-5 mm diametro.

A shrub 1 to 2 m tall, the branchlets, leaves, and infructescences densely pubescent. Leaves greenish, elliptic to lanceolate-elliptic, chartaceous, 10 to 20 cm long, 4.5 to 8 cm wide, base acute or subacute, the apex rather abruptly acuminate, margins minutely glandular-denticulate or dentate, densely pubescent on both surfaces, particularly the midrib and lateral nerves beneath; lateral nerves 5 or 6 on each side of the midrib, curved-ascending, arched-anastomosing, prominent; petioles densely pubescent, 2.5 to 10.5 cm long. Staminate and pistillate flowers not seen. Infructescences abbreviated, up to 4 cm in length, in some cases almost sessile. Capsules subglobose, very densely pubescent, 1.2 to 1.5 cm in diameter, 3-celled; the peduncles up to 4 mm long. Seeds globose, glabrous, rugose, 4 to 5 mm in diameter.

LUZON, Camarines Sur Province, Paganan River, *Bur. Sci. 76416 Edaño* (type), December 1, 1928, along streams, altitude about 900 m; Her-it River, *Bur. Sci. 76455 Edaño*, December 6 1928, on forested slopes, altitude about 900 m; Agosais, *Bur. Sci. 76119 Edaño*, October 24, 1928, in damp forests, altitude about 500 m; Adiagnao, *Bur. Sci. 6379 Robinson*, August 29, 1908. CATANDUANES, Dakulangpatag, *Bur. Sci. 75376 Ramos & Edaño*, August 24, 1928, along streams in forests, altitude about 700 m.

A species entirely distinct from all previously described Philippine forms, apparently allied to *C. subviride* Elm. It is readily distinguished by its very pubescent branchlets, leaves, petioles, and capsules. The hairs on the capsules are long and rather stiff.

## ANACARDIACEÆ

### Genus SEMECARPUS Linnæus f.

**SEMECARPUS OBLONGIFOLIA Quis. sp. nov.**

Affinis *S. lanceolata* Merr. Arbor glabra, 8–15 m alta; foliis coriaceis, oblongis vel oblongo-ellipticis, ad 18 cm longis et 6 cm latis, basi acutis, apice abrupte acuminatis, nervis utrinque circiter 10 prominentibus, supra nitidis, subtus in sicco pallidioribus, reticulis prominentibus; petiolis ad 5.5 cm longis; paniculis glabris, ad 22 cm longis; drupis reniformibus, compressis, breviter carinatis, 1.5-1.7 cm latis.

A tree 8 to 15 m high, glabrous. Branches slender, the ultimate ones about 5 mm in diameter, grayish brown. Leaves

oblong or oblong-elliptic, 9 to 18 cm long, 3 to 6 cm wide, base acute, apex abruptly acuminate, the acumen obtuse, coriaceous, shining on the upper surface, paler on the lower when dry; lateral nerves about 10 on each side of the midrib, prominent, spreading, faintly anastomosing, the reticulations on both surfaces distinct; petioles 2.5 to 5.5 cm long. Inflorescences and flowers not seen. Fruiting panicles terminal, glabrous, up to 22 cm long. Torus when dry 8 to 10 mm long, 6 to 7 mm wide at the tip, narrowed below; the peduncle as long as the torus. Drupe reniform, compressed, 1.5 to 1.7 cm wide, 1.3 to 1.4 cm wide, somewhat keeled.

LUZON, Tayabas Province, Guinayangan, Barrio Malbog, *For. Bur. 30688 Oro* (type), January 23, 1929, on forested slopes, altitude about 80 m; *For. Bur. 30641 Ladia,* January 20, 1929, on a ridge, altitude about 200 m.

Apparently allied to *S. lanceolata* Merr. differing in its oblong or oblong-elliptic, abruptly acuminate leaves. Further, the lateral nerves are quite prominent and fewer in number (about 10), and the branchlets are decidedly more slender.

## SAPINDACEÆ

### Genus ALLOPHYLUS Linnæus

**ALLOPHYLUS SIMPLEX Quis. sp. nov.**

Frutex 1 m altus; foliis unifoliolatis, oblanceolatis vel oblongo-ellipticis, 19–23.5 cm longis, 5.5–7 cm latis, utrinque glabris, chartaceis, basi acutis, apice perspicue acuminatis, ex margine ad apicem irregulariter lobato-serratis, dentibus acutis; petiolo glabro, 1.5–2.5 cm longo. Inflorescentiis axillaribus, simplicibus, tenuibus, brevibus, 3–5 cm longis; pedunculo 0.5–1 cm longo; sepalis 4, extus glabris, margine obscure pubescentibus; petalis 4, villosis.

An undershrub 1 meter in height (Merrill); stem terete, glabrous, unbranched, lenticellate, young grayish or grayish brown at the base. Leaves 1-foliolate, oblanceolate or oblong-elliptic, 19 to 23.5 cm long, 5.5 to 7 cm wide, chartaceous, glabrous on both surfaces, the upper surface brownish-olivaceous, the lower paler, equally or subequally narrowed to the acute base, the apex prominently acuminate, the margins at the base usually entire, towards the apex irregularly lobe-toothed, sinuses broad and shallow, the teeth short and acute and less than 1 cm long; midrib, nerves and reticulations brownish; the lateral nerves about 10 on each side of the midrib; petioles glabrous,

slender, short, 1.5 to 2.5 cm long. Inflorescences axillary, very slender, 3 to 5 cm long; peduncles somewhat pubescent, very short, 0.5–1 cm long. Flowers minute, white (Merrill), their pedicels 1 to 1.25 mm long. Sepals 4, glabrous without, their margins obscurely pubescent, concave, imbricate, suborbicular, 1.5 to 2 mm long. Petals 4, subtruncate, narrowed below, about 1 mm long, densely villose. Stamens 8, in center of flower; filaments villose, 0.5 to 0.75 mm long; anthers suborbicular-elliptic, 0.4 to 0.5 mm in diameter; cells contiguous, parallel.

PALAWAN, Malampaya Bay, *Merrill 7262* (type), September 18, 1910, in forests at low altitudes; same locality, *Merrill 11576*, in primary forests, at low altitudes, October 8, 1922. BALABAC, Palawan Province, *Bur. Sci. 49706 Ramos & Edaño*, November 22, 1922.

Belonging to the group of 1-foliolate *Allophylus*, and closely related to *A. simplicifolius* Radlk. differing conspicuously in its very short slender inflorescences, shorter petioles; and margins of the leaves, which are usually entire at the base, irregularly lobe-toothed towards the apex, the sinuses broad and shallow, and the teeth short and acute.

## VITACEÆ

### Genus CAYRATIA Jussieu

In accordance with action taken by the Botanical International Congress, the genus *Cayratia* of Jussieu is conserved in preference to *Columella* of Loureiro. This is frankly desirable because of possible confusion of *Columella* Lour. (1790) with *Columellia* Ruiz & Pav. (1794), the latter typifying the family Columelliaceæ. Merrill notes, however, that *Lagenula* Lour. 1790 is also synonymous with *Columella* Lour. and *Cayratia* Juss. [Trans. Am. Philos. Soc. II $24^2$ (1835) 255] but now that *Cayratia* Juss. has been conserved, *Lagenula* Lour. cannot replace it. This action necessitates some changes in nomenclature in relation to the Philippine species of the genus.

**CAYRATIA APOENSIS (Elm.) Quis. comb. nov.**

*Columella apoensis* (Elm.) MERR. in Enum. Phil. Fl. Pl. 3 (1923) 8.
*Cissus apoensis* ELM., Leafl. Bot. 8 (1915) 2880.

**CAYRATIA CORNICULATA (Benth.) Gagnep.**

*Columella corniculata* (Benth.) MERR. in Philip. Journ. Sci. 11 (1916) Bot. 133, Enum. Philip. Fl. Pl. 3 (1923) 8.
*Vitis corniculata* BENTH., Fl. Hongkong (1861) 54.
*Cissus corniculata* PLANCH. in DC. Monog. Phan. 5 (1887) 563.

*Cayratia corniculata* GAGNEP. in Not. Syst. 1 (1911) 347.

*Cayratia japonica* GAGNEP. in Not. Syst. 1 (1911) 349, quoad Philip.; MERR. in Philip. Journ. Sci. 1 (1906) Suppl. 89, non *Vitis japonica* Willd.

**CAYRATIA GENICULATA (Blume) Gagnep.**

*Cissus geniculata* BLUME, Bidjr. (1825) 184; A. GRAY, Bot. Wilkes U. S. Explor. Exped. (1854) 272; PLANCH. in DC. Monog. Phan. 5 (1887) 572.

*Vitis geniculata* MIQ., Ann. Mus. Bot. Ludg.-Bat. 1 (1863) 81; F.-VILL., Novis. App. (1880) 49.

*Cissus rubescens* BLANCO, Fl. Filip. (1837) 71.

*Cissus alata* BLANCO, Fl. Filip. ed. 2 (1845) 51, ed. 3 1 (1877) 95, non Jacq.

*Cayratia geniculata* GAGNEP. in Not. Syst. 1 (1911) 345.

*Columella geniculata* (Blume) MERR. in Philip. Journ. Sci. 11 (1916) Bot. 132, Sp. Blancoanae (1918) 246, Enum. Philip. Fl. Pl. 3 (1923) 8.

**var. SARCOCARPA (Merr.) Quis. comb. nov.**

*Columella geniculata* (Blume) MERR. var. *sarcocarpa* MERR. in Philip. Journ. Sci. 11 (1916) Bot. 133, Enum. Philip. Fl. Pl. 3 (1923) 8.

**CAYRATIA MOLLISSIMA (Wall.) Gagnep.**

*Vitis mollissima* WALL., Fl. Ind. ed. 2 2 (1832) 482; LAWS in Hook. f. Fl. Brit. Ind. 1 (1875) 656; PLANCH. in DC. Monog. Phan. 5 (1887) 575.

*Cissus mollissima* PLANCH. in DC. Monog. Phan. 5 (1887) 575.

*Cayratia mollissima* GAGNEP. in Not. Syst. 1 (1911) 345.

*Columella mollisima* (Wall.) MERR. in Enum. Philip. Fl. Pl. 3 (1923) 8.

**CAYRATIA PEDATA (Lam.) Juss.**

*Cissus pedata* LAM., Encycl. 1 (1783) 31; PLANCH. in DC. Monog. Phan. 5 (1877) 558.

*Columella pedata* LOUR., Fl. Cochinch. (1790) 85; MERR. in Philip. Journ. Sci. 11 (1916) Bot. 134, Enum. Philip. Fl. 3 (1923) 9.

*Cayratia pedata* JUSS., Dict. Class. Hist. Nat. 4 (1823) 136; GAGNEP. in Not. Syst. 1 (1911) 346.

*Vitis pedata* VAHL ex WALL. Cat. (1832) No. 6027; LAWS in Hook. f. Fl. Brit. Ind. 1 (1875) 661; F.-VILL., Novis. App. Fl. Filip. (1880) 50.

**CAYRATIA PTERITA (Merr.) Quis. comb. nov.**

*Columella pterita* MERR. in Philip. Journ. Sci. 11 (1916) Bot. 135, Enum. Philip. Fl. Pl. 3 (1923) 9.

**CAYRATIA SIMPLICIFOLIA (Merr.) Quis. comb. nov.**

*Columella simplicifolia* MERR. in Philip. Jorun. Sci. 11 (1916) Bot. 135, Enum. Philip. Fl. Pl. 3 (1923) 9.

**CAYRATIA TENUIFOLIA (Heyne) Gagnep.**

*Cissus tenuifolia* HEYNE in Wall. Cat. (1831) No. 6022; PLANCH. in DC. Monog. Phan. 5 (1887) 563.

*Vitis tenuifolia* W. & A., Prodr. (1834) 129.

*Cayratia tenuifolia* GAGNEP. in Not. Syst. 1 (1911) 348.
*Columella tenuifolia* (Heyne) MERR. in Philip. Jorun. Sci. 11 (1916) Bot. 134, Enum. Philip. Fl. Pl. 3 (1923) 9.

**CAYRATIA TRIFOLIA (Linn.) Quis. comb. nov.**

*Vitis trifolia* LINN., Sp. Pl. (1753) 293.
*Cissus carnosa* LAM., Encycl. 1 (1783) 31; PLANCH. in DC. Monog. Phan. 5 (1887) 570.
*Cissus acida* BLANCO, Fl. Filip. (1837) 69, ed. 2 (1845) 50, ed. 3 1 (1877) 94, *t. 24*, non Linn.
*Vitis carnosa* WALL., Cat. (1831) No. 6081; LAWS. in Hook. f. Fl. Brit. Ind. 1 (1875) 654; F.-VILL., Novis. App. (1880) 49; VIDAL, Sinopsis Atlas (1883) 21, *t. 33, f. A.*
*Cissus trifolia* K. SCHUM., Fl. Kaiser Willhelmsl. (1889) 71; MERR., Fl. Manila (1912) 311.

**var. CINEREA (Lam.) Quis. comb. nov.**

*Cissus cinerea* LAM., Tabl. Encycl. 1 (1791) 332.
*Columella trifolia* (Linn.) MERR. var. *cinerea* (Lam.) MERR., Enum. Philip. Fl. Pl. 3 (1923) 10.

## Genus LEEA Royen

**LEEA CATANDUANENSIS Quis. sp. nov.**

Frutex 1–2 m altus, glaber; ramis canaliculatis; foliis unifoliolatis, oblanceolatis, ad 50 cm longis, et 19.5 cm latis, chartaceis, apice acutis, basi obtusis, margine dentatis, nervis lateralibus utrinque 19–20, subtus perspicuis; petiolo ad 9 cm longo; infructescentiis in axillis superioribus, circiter 8 cm longis; fructibus nigrescentibus, nitidis, triangularibus vel quadratis, supra compressis, circiter 8–10 mm latis, seminibus 3 vel 4.

A shrub 1 to 2 m high, glabrous throughout; branches and branchlets deeply furrowed, dark brown when dry, the ultimate branchlets 8 to 10 mm in diameter. Leaves simple, oblanceolate, 45 to 50 cm long, 18 to 19.5 cm wide, chartaceous, narrowed to the acute apex, the base narrowed obtuse, margins somewhat regularly dentate, the upper surface dark brown when dry, the lower paler; lateral nerves 19 to 20 on each side of the midrib, prominent, ascending, the reticulations distinct; petioles furrowed, not winged, 8 to 9 cm long. Infructescences in the upper axils, about 8 cm long, sparingly branched. Fruits triangular or quadrate, (depressed on top), 8 to 10 mm wide, smooth, black when dry, each with 3 or 4 seeds.

CATANDUANES, Virac, *Bur. Sci. 75429 Ramos & Edaño,* August 1, 1928, in damp forests, at low altitude.

This species belongs in the group of species with simple leaves (*L. banahaensis* Elm., *L. pycnantha* Quis. & Merr., and *L. mag-*

*nifolia* Merr.), and is most closely allied to *L. magnifolia* Merr. from which it is readily distinguished by its smaller and oblanceolate, acute leaves, and the wingless petioles.

## DILLENIACEÆ

### Genus SAURAUIA Willdenow

**SAURAUIA CORDATA Quis sp. nov.**

Frutex circiter 2 m altus, ramulis junioribus inflorescentiisque adpresse breviter setosis; foliis ovatis vel oblongo-ovatis, 16.5–23 cm longis, 8–11 cm latis, subcoriaceis, basi cordatis, apice breviter acuminatis, margine minute denticulatis, nervis utrinque 12 vel 13 perspicuis, supra, costam nervisque perspicue adpresse breviter setosis exceptis glabris, subtus dense pubescentibus; petiolo 2.5–4.5 cm longo; inflorescentiis axillaribus, 2–3 cm longis, breviter pedunculatis, solitariis vel fasciculatis, 1–4 floris; floribus 5.5–6 mm longis; pedicellis gracilibus, 7–9 mm longis; sepalis subaequalibus, oblongis, obtusis, 4.5–5.5 mm longis, 2.5–3.5 mm latis, leviter cucullatis, breviter adpresse setosis; corolla ignota; staminibus ignotis; ovario subgloboso, breviter piloso; stylis 3, basi unitis; fructibus subglobosis, circiter 4.5 mm diametro; seminibus minutis, numerosis.

A shrub about 2 m high, the younger branches and inflorescences appressed-setose, the setae very short. Leaves ovate or oblong-ovate, 16.5 to 23 cm long, 8 to 11 cm wide, subcoriaceous, base cordate, apex shortly acuminate, at maturity the upper surface glabrous except the midrib and nerves, the lower surface densely shortly appressed-setose, the margins minutely denticulate; lateral nerves 12 or 13, prominent, anastomosing; petioles densely pubescent, 2.5 to 4.5 cm long. Inflorescences axillary, solitary or fascicled, 2 to 3 cm long, 1- to 4-flowered, the peduncles very slender, short. Flowers evidently pistillate only, 5.5 to 6 mm long, their pedicels very slender, densely pubescent, 7 to 9 mm long, each with minute bracteoles. Sepals subequal, oblong, obtuse, 4.5 to 5.5 mm long, 2.5 to 3.5 mm wide, slightly cucullate, shortly appressed-setose. Petals not seen. Stamens not seen. Ovary subglobose, slightly pilose; styles 3, united at the base, the arms 2 to 3 mm long. Fruits capsular, about 4.5 mm in diameter, glabrous; seeds numerous, minute.

CATANDUANES, Mt. Abucay, *Bur. Sci. 75267 Ramos & Edaño*, September 9, 1928, on damp forests, altitude about 1,300 m.

A very characteristic species distinguished by its ovate or oblong-ovate leaves which are cordate at the base.

**SAURAUIA GIGANTIFOLIA Quis. sp. nov.**

Frutex circiter 3 m altus; truncis junioribus petiolisque valde setosis, setis ad 7 mm longis; foliis magnis, late oblanceolatis, 24.5–33.5 cm longis, 13.5–20 cm latis, apice mucronatis vel brevissime acuminatis, basi attenuatis, obtusis; nervis utrinque 13 vel 14, utrinque costa nervisque exceptis parcissime setosis glabris; petiolo 1.5–2.5 cm longo, valde setoso; inflorescentiis caulinis, numerosis, fasciculatis, 2–4 cm longis; bracteis ovatis, acutis, 6.5–11 mm longis, 4–9 mm latis, glabris, margine plus minusve setosis; pedunculis glabris; sepalis late ovatis, subacutis vel obtusis, glabris, 7–9 mm longis, 6–10 mm latis, margine minute setosis; petalis glabris, oblongis, retusis, 10–12.5 mm longis, 7.5–9.5 mm latis; staminibus numerosis, glabris, 4–4.5 mm longis; ovario glabro, subgloboso; stylis 4, gracilibus, 4–4.5 mm longis, ad basim connatis.

A shrub about 3 m high, glabrous except the growing tips of stems and petioles which are very conspicuously clothed with long setae. The young stems stout, much wrinkled when dry, about 1 cm in diameter, the growing tips very densely and conspicuously long-setose. Leaves large, broadly oblanceolate, 24.5 to 33.5 cm long, 13.5 to 20 cm wide, subcoriaceous, glabrous on both surfaces, except the midrib and lateral nerves which are sparsely setose, narrowed to the obtuse base, the apex mucronate or very shortly acuminate, margins closely and minutely setose. Inflorescences from the trunk, few-flowered, numerous, fascicled, 2 to 4 cm long; the bracts somewhat cucullate, ovate, acute, 6.5 to 11 mm long, 4 to 9 mm wide (when flattened), glabrous except for the very few short setae on the margins, 1 to 2 cm long. Flowers white (Ramos & Edaño), about 2 cm across, the pedicels slender, glabrous, the bracteoles of the same shape as the bracts but smaller, in pairs at the base of the pedicels; sepals 5, subequal, broadly ovate, subacute or obtuse, 7 to 9 mm long, 6 to 10 mm wide, glabrous except the setose margins; petals 5, subequal, glabrous, oblong, retuse, 10 to 12.5 mm long, 7.5 to 9.5 mm wide, the lobes subequal; stamens numerous, glabrous, 4 to 4.5 mm long, the anthers appendiculate, as long as the filaments; ovary subglobose, glabrous, the styles 4, slender, united at the base, the arms 4 to 4.5 mm long.

MINDANAO, Agusan Province, Mt. Diuata, *Bur. Sci. 33716 Ramos & Convocar,* April 10, 1931, on forested slopes, altitude about 1,000 m.

A species in the group with cauline inflorescences, closely allied to *S. ampla* Merr. but differing in its broadly oblanceolate

leaves, shorter inflorescences, and the presence of many conspicuous bracts. The growing tips of the stems and the petioles, clothed with unusually long and very prominent setae, are important distinguishing features of this species.

**SAURAUIA KNEMAEFOLIA Quis. sp. nov.**

Frutex circiter 2 m altus, truncis junioribus, petiolis, foliis subtus et inflorescentiis densissime cinnamomeo-pubescentibus, vix setosis; foliis oblongis vel oblongo-ellipticis, 22–39 cm longis, 8–10 cm latis, subcoriaceis, utrinque acutis, margine perspicue subglanduloso-denticulatis; nervis utrinque 27–32, perpicuis; inflorescentiis axillaribus, 5–8 cm longis, paucifloris; floribus magnis, circiter 3 cm diametro; sepalis subequalibus, extus pubescentibus, suborbicularibus, rotundatis, 1.3–1.8 cm longis, 1.2–1.8 cm latis; petalis oblongis, retusis, glabris, 1.4–1.5 cm longis, 1–1.2 cm latis; ovario subgloboso, dense pubescente, stylis 5, glabris, 7–8 mm longis, ad basim connatis; staminibus glabris, numerosis, 4–5 mm longis.

A shrub about 2 m high, the young stems, petioles, the lower surface of the leaves, and inflorescences very densely cinnamomeo-pubescent, the indumentum felted, not setose. Branches terete, reddish brown, becoming glabrous with age, the young branches and petioles with few, scattered appressed scales. Leaves oblong to oblong-elliptic, 22 to 39 cm long, 8 to 10 cm wide, subcoriaceous, narrowed at both ends, acute, the margins, except near the base, conspicuously denticulate with glandlike teeth about 1 mm in length, the upper surface smooth, glabrous, and dark brown, the lower surface much paler; lateral nerves 27 to 32 on each side of the midrib, prominent, ascending, the reticulations slender and obscure; petioles 1.7 to 2 cm long, the younger ones densely cinnamomeo-pubescent, the older ones glabrous. Inflorescences axillary, few-flowered, never 1-flowered, 5 to 8 cm long, longer than the petioles; the bracts oblong-elliptic, narrowed at both ends, acute, up to 2 cm long, the bracteoles smaller, up to 1 cm long, 0.5 cm wide. Flowers white (Edaño), large, about 3 cm in diameter; sepals subequal, cinnamomeo-pubescent without, suborbicular, rounded, 1.3 to 1.8 cm long, 1.2 to 1.8 cm wide; petals white, glabrous, oblong, retuse, 1.4 to 1.5 cm long, 1.0 to 1.2 cm wide; ovary subglobose, very densely cinnamomeo-pubescent, becoming glabrous with age, styles 5, glabrous, the arms 7 to 8 mm long, united at the base; stamens glabrous, numerous, 4 to 5 mm long.

PALAWAN, Mt. Manalsal, *Bur. Sci. 77764 Edaño*, May 13, 1929, on forested slopes, altitude about 1,200 m.

A unique species, in its indumentum similar to *S. bicolor* Merr. and perhaps allied to it, differing however, in its larger, oblong to oblong-elliptic leaves with numerous (27 to 32) lateral nerves, longer and larger inflorescences and larger flowers, and in having five styles. When dry, the leaves remind one of those of some species of *Knema*.

**SAURAUIA RAMOSII Quis. sp. nov.**

Frutex circiter 2 m altus, ramulis junioribus inflorescentiisque parcissime breviter adpresse furfuraceo-setosis; foliis oblanceolatis vel elliptico-oblanceolatis, ad 20 cm longis et 7.5 cm latis, costa nervisque sparsissime et parcissime breviter adpresse furfuraceo-setosis, exceptis glabris, apice breviter acuminatis vel raro acutis, basi attenuatis, subacutis vel obtusis; nervis utrinque 8–10, obscuris; bracteis suborbicularibus, subacutis vel obtusis, 1.0–1.5 cm longis, 1.0–1.3 cm latis, glabris; inflorescentiis axillaribus, paucifloris, 4–8 cm longis; pedunculis sparse pubescentibus, gracilibus, 3.5–6.5 cm longis; floris circiter 1.5 cm diametro; sepalis extus parcissime breviter adpresse furfuraceo-setosis, subequalibus, anguste oblongis vel late ovatis, obtusis, circiter 6 mm longis, 3–5.5 mm latis; petalis oblongis, retusis, glabris, 8–9 mm longis, 4–5 mm latis; ovario glabro, ovoideo; stylis 3, circiter 4 mm longis, ad basim connatis; staminibus numerosis.

A shrub about 2 m high, the young branchlets densely covered with short closely appressed scalelike setae. Branches terete, reddish brown. Leaves subcoriaceous, oblanceolate to elliptic-oblanceolate, 10 to 20 cm long, 4 to 7.5 cm wide, glabrous on both surfaces except the midrib and lateral nerves which bear few scattered short appressed scalelike setae, the apex shortly acuminate or rarely acute, narrowed below to the subacute or obtuse base, the margins irregularly glandular-denticulate, the glands less than 0.5 mm in length, the upper surface atro-olivaceous, the lower surface brown; lateral nerves 8 to 10 on each side of the midrib, obscure, the reticulations very obscure; petioles 1.5 to 4.8 cm long, with few scattered appressed scalelike setae, the older ones becoming glabrous. Inflorescences axillary, few-flowered, 4 to 8 cm long; the peduncles slender, sparsely pubescent, 3.5 to 6.5 cm long; the bracts suborbicular, subacute or obtuse, 1.0 to 1.5 cm long, 1.0 to 1.3 cm wide, gla-

brous. Flowers white (Ramos and Edaño), about 1.5 cm in diameter, the pedicels very slender, 5 to 6 mm long, with few scattered short appressed scalelike setae, the bracteoles smaller than the bracts, otherwise similar in shape, pubescent. Sepals 5, subequal, the two outer broadly ovate, obtuse, about 6 mm long, 5 to 5.5 mm wide, with few appressed scalelike setae on the outside, the three inner narrowly oblong, obtuse, about 6 mm long, 3 to 3.5 mm wide, thinner. Petals 5, oblong, retuse, 8 to 9 mm long, 4 to 5 mm wide, glabrous. Ovary glabrous, ovoid, styles 3, about 4 mm long, the arms as long as the united base. Stamens glabrous, numerous.

CATANDUANES, Mt. Abucay, *Bur. Sci. 75497 Ramos & Edaño*, September 9, 1928, in damp forests, altitude about 1,500 m.

Doubtless belonging in the *S. latibracteata* Choisy group, differing conspicuously from this species in its indumentum, shape and color of the leaves, and details of the inflorescences and flowers. Named in memory of Maximo Ramos, a great collector, who died on active duty while collecting in the wilds of Mt. Matutum, Cotabato, Mindanao.

## MYRSINACEÆ

### Genus LOHERIA Merrill

**LOHERIA MAGNIFOLIA Quis. sp. nov.**

Frutex erectus vix ramosus, inflorescentiis exceptis glaber; foliis coriaceis, permagnis, late oblanceolatis, 37–51 cm longis, 9.5–16.5 cm latis, breviter late acuminatis, acuminibus acutis ad obtusis, basi attenuatis, integris vel sursum denticulatis, subtus dense minute glandulosis, nervis primariis utrinque 17–24, valde perspicuis; inflorescentiis ♀ anguste paniculatis, pedunculatis, 6–8 cm longis, bracteis imbricatis, numerosis, oblongis, acutis, 2–5.5 cm longis; floribus confertis, 4-meris; sepalis triangulari-ovatis, acutis ad subacutis, 0.7–1 mm longis, puberulis, margine ciliolatis; petalis oblongo-ellipticis vel oblongo-ovatis, obtusis, 2–2.25 mm longis; ovario oblongo-ovoideo, glabro, circiter 2 mm longo; inflorescentiis floribusque ♂ more ♀; staminibus 4, filamentis quam antheris paullo longioribus; fructibus globosis, 5.5–6 mm diametro, glabris, perspicue apiculatis, longitudinaliter striatis.

An erect unbranched shrub about 1 m high, glabrous except the puberulent inflorescence. Stem brown, terete, woody, 1 to 1.7 cm in diameter at the summit. Leaves large, crowded at the apices of the stems, alternate, broadly oblanceolate, coria-

ceous, 37 to 51 cm long, 9.5 to 16.5 cm wide, entire throughout or obscurely repand-dentate near the apex, smooth and shining on both surfaces, glabrous, the apex very broadly and shortly acuminate, the acumen acute or blunt, gradually narrowed from the middle to the base, the lower surface very densely and minutely glandular-punctate; primary lateral nerves 17 to 24 on each side of the midrib, very prominent, ascending, anastomosing, the reticulations lax, distinct; petiole very stout, 1 cm or less or almost obsolete. Pistillate inflorescences crowded at the apex, axillary, narrowly paniculate, densely flowered, 6 to 8 cm long, the peduncles 2.5 to 3 cm long; the bracts oblong, acute, chartaceous, 2 to 5.5 cm long, brown, numerous, many-seriate, imbricate. Flowers 4-merous, subumbellately and racemosely disposed, the pedicels puberulent, rather stout, 0.75 to 1.5 mm long, the bracts lanceolate, acuminate, 1.5 to 2 mm long, the bracteoles smaller. Calyx 4-lobed, about 2 mm in diameter, the lobes triangular-ovate, acute to subacute, 0.7 to 1 mm long, 0.6 to 0.8 mm wide, spreading in anthesis, united for their lower one-half, puberulent, conspicuously glandular, the margins ciliolate. Petals 4, oblong-elliptic to oblong-ovate, obtuse, 2 to 2.25 mm long, about 1.5 mm wide, glabrous, conspicuously glandular, imbricate, reflexed in anthesis, united at the base, the tube up to 0.5 mm long. Staminodes 4, 1 to 1.25 mm long. Ovary oblong-ovoid, glabrous, about 2 mm long, stigma sessile. Staminate inflorescences similar to the female ones, puberulent, paniculate, numerous near the apices of the stems, 8.5 to 16 cm long, the branches numerous, up to 3 cm long, the bracts similar to those of the pistillate inflorescences. Staminate flowers 4-merous, numerous, racemosely diposed, the pedicels slender, densely puberulent, 1.5 to 2 mm long, the bracts, bracteoles, sepals, and petals similar to those of the pistillate flowers. Stamens 4, 1.75 to 2 mm long, the filaments slightly longer than the anthers which are triangular and somewhat sagittate at the base, acute. Ovary rudimentary, subulate, about 1.75 mm long. Fruits globose, 5.5 to 6 mm in diameter, glabrous, conspicuously apiculate, longitudinally striate, 1-seeded, albumen ruminate.

LUZON, Nueva Vizcaya Province, Mount Alzapan, *Bur. Sci. 45638* (type), *76569 Ramos & Edaño* (fruiting specimen), May 24, 1930 and May 30, 1930, respectively, on forested slopes, altitude about 1,700 meters or along forest streams at low altitudes: Rizal Province, without definite locality, *Loher 14871* (female plant).

A remarkable species, without doubt belonging to this genus, as characterized by E. D. Merrill, differing from *Loheria porteana* (Mez) Merr. in its very large, coriaceous, oblanceolate leaves.

## FLACOURTIACEÆ

### Genus CASEARIA Jacquin

**CASEARIA HYDNOCARPOIDES Quis. sp. nov.**

Frutex circiter 4 m altus, glaber; foliis integerrimis, oblongis vel oblongo-ovatis, ad 12.5 cm longis et 6 cm latis, utrinque nitidis, apice acutis, basi inaequilateralibus, acutis vel subacutis, nervis utrinque circiter 5, reticulis tenuibus distinctis; petiolo 7–9 mm longo; floribus axillaribus, fasciculatis, 5-meris, pedicellatis; staminibus 8, filamentis 1.5–1.75 mm longis; staminoidiis anguste oblongis, ciliatis; ovario ciliato.

Shrub about 4 m high, glabrous throughout except the flowers. Leaves entire, oblong or oblong-ovate, 11 to 12.5 cm long, 5 to 6 cm wide, apex acute, the base inequilaterally acute or subacute, chartaceous, olivaceous-brown, shining on both surfaces; lateral nerves about 5 on each side of the midrib; the reticulations on both surfaces slender and very distinct; petioles glabrous, 7 to 9 mm long. Flowers greenish white, fascicled; the pedicels glabrous, 2 to 3 mm long. Sepals 5, broadly ovate, obtuse, about 3 mm long, 2.5 to 3 mm wide, ciliate within. Fertile stamens 8, the glabrous filaments 1.5 to 1.75 mm long; staminodes alternating the stamens, shorter than the stamens, narrowly oblong, ciliate. Ovary ciliate at the base of the style.

PALAWAN, Taytay, *Merrill 9366*, May 9, 1913, on forested slopes, at low altitudes.

The species is well characterized by being entirely glabrous (except the flowers) with oblong or oblong-ovate, shining and reticulate leaves. It is allied to *C. trivalvis* (Blanco) Merr. differing in the shape and very prominent reticulate leaves and details of floral parts. The general appearance of the leaves, their texture, venation, etc. are strikingly like those of some species of *Hydnocarpus*.

**CASEARIA WENZELII Merrill & Quisumbing sp. nov.**

Arbor parva, partibus junioribus floribusque exceptis glabris; foliis chartaceis, magnis, oblongis, usque ad 23.5 cm longis et 10.8 cm latis, apice mucronatis, basi subacutis; nervis utrinque 9–10, supra obscuris; petiolo 8–10 mm longo; floribus axillaribus, fasciculatis, 5-meris, pedicellatis; staminibus 10, fila-

mentis ciliatis, 1.25–1.5 mm longis; staminoidiis anguste oblongis, ad apicem dense ciliatis, circiter 1.5 mm longis, 0.5 mm latis; ovario ovoideo, ciliato, stigmatibus capitatis.

A small tree, quite glabrous except the growing tips of the branchlets and leaves which are densely hirsute with very short hairs. Leaves large, chartaceous, oblong, 16.5 to 23.5 cm long, 10 to 10.8 cm wide, apex mucronate, base subacute, the margins entire, glabrous on both surfaces with age, the upper surface dark brown when dry, the lower paler; lateral nerves 9 to 10 on each side of the midrib, rather prominent on the lower surface, the upper obscure, the reticulations somewhat obscure; petioles glabrous, 8 to 10 mm long. Flowers axillary, numerous, fascicled. Pedicels very slender, ciliate, 1.25 to 1.5 mm long. Sepals 5, unequal (two flat and the three concave) oblong or broadly oblong, obtuse, on the outer surface ciliate, membranaceous, 4 to 4.5 mm long, 2.25 to 2.5 mm wide. Stamens 10, their filaments ciliate, united below with alternating staminodes, 1.25 to 1.5 mm long, twice as long as the anthers. Staminodes narrowly oblong, densely ciliate particularly at the apex, about 1.5 mm long, 0.5 mm wide. Ovary ovoid, ciliate; style very short; stigma capitate.

MINDANAO, Surigao Province, Surigao, *Wenzel 3026*, August 9, 1927.

Species belonging to *C. fuliginosa* Blanco group, differing conspicuously in its large, oblong, mucronate leaves.

# SOME TREMATODE PARASITES OF FISHES IN THE COLLECTION OF THE UNIVERSITY OF THE PHILIPPINES

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*Of the Institute of Science and Technology, Manila*

TWO PLATES

Through the courtesy of Dr. Amado T. Feliciano, of the Department of Zoology, Junior College, University of the Philippines, we have been able to examine some trematode parasites of fishes collected by students majoring in ichthyology. Eight species have been identified, of which 3 appear to be new. We wish to record our thanks to Doctor Feliciano for placing the material at our disposal.

## Family BUCEPHALIDÆ Poche, 1907

**PROSORHYNCHUS TRIANGULARIS sp. nov. Plate 1, fig. 1.**

A single specimen of this parasite is found in the collection.

*Description.*—Body elongated, 1.35 by 0.27 millimeters. Cuticle armed with numerous small spines. Rhynchus well developed, roughly triangular in outline, 0.20 by 0.14 millimeter. Pharynx equatorial, 0.06 millimeter in diameter; œsophagus short; intestine saccular, anterior to pharynx, 0.21 by 0.13 millimeter.

Testes globular, one immediately and obliquely behind the other; first testis 0.13 millimeter in diameter, on the left side of pharynx and partly overlapped by latter in ventral view; second testis 0.12 millimeter across, behind pharynx. Cirrus sac 0.35 by 0.07 millimeter, in posterior third of body length, about 0.14 millimeter from posterior extremity; incloses small, coiled vesicula seminalis and long straight cirrus, the greater length of which is surrounded by numerous prostatic cells. Genital pore median, ventral, about 0.10 millimeter from posterior end of body, leads to genital sinus.

Ovary subglobular, 0.08 millimeter in diameter, on right side of median line opposite anterior testis and partly overlapped in ventral view by antero-lateral border of pharynx. Oviduct

originates from posterior border of ovary. Shell gland and ootype complex lateral to pharynx, between ovary and second testis. Uterus confined in posterior region of body, behind testes. Vitellaria lateral, in roundish follicles, of which there are 15 on the left side (arranged in 5 groups of 3 each) and 13 on the right side; they extend from level of anterior border of intestine to level of posterior border of second testis. Eggs oval, slightly asymmetrical, yellowish, thick-shelled, operculated, 30 to 32 by 18.5 to 20 microns; some of them show at the abopercular end a filament similar to that described by Eckmann (1932) for the egg of *Prosorhynchus crucibulus*.

Excretory pore posteroterminal.

*Host.*—*Glossogobius giurus.*[1]

*Location.*—Intestine.

*Locality.*—Manila.[2]

*Type specimen.*—Philippine Bureau of Science parasitological collection No. 660 (deposited in the Bureau of Science for safekeeping).

Of the known members of the genus *Prosorhynchus* Odhner, 1905, this trematode most closely resembles *P. crucibulus* (Rudolphi, 1819), as described by Eckmann (1932). It may be distinguished from the latter by the following characters: the arrangement of the genital glands and the extent of the uterus and the vitelline glands. In *P. triangularis* the testes and ovary are arranged in triangular fashion around the pharynx; in *P. crucibulus* they are arranged in linear series on one side of the pharynx or the testes may be located behind the pharynx with the ovary on the medial side of the first testis. The uterus of *P. triangularis* is confined in the posterior region of the body behind the testes, while that of *P. crucibulus* reaches anteriorly to the anterior level of the intestine. In *P. triangularis* the vitellaria reach posteriorly to the posterior level of the second testis, while in *P. crucibulus* they extend only as far as the anterior level of that organ.

## Family ALLOCREADIIDÆ Stossich, 1904

**ORIENTOCREADIUM BATRACHOIDES Tubangui, 1931.**

There are three specimens of this trematode, one from *Clarias batrachus*, the type host, and two from *Glossogobius giurus* which

[1] The scientific names of the fish hosts are according to the Check-list of Philippine Fishes by Roxas and Martin (1937).

[2] While some of the fish hosts might have been caught in Manila, the others might have been shipped to the city from towns around Lake Bay.

is here recorded for the first time as a host of the parasite. The specimens have been examined carefully in view of the question raised by Yamaguti (1934) regarding the presence of a vesicula seminalis interna. In two individuals the continuation of the external seminal vesicle within the cirrus sac is slightly dilated and filled with spermatozoa. The presence of this structure which is not visible in the type specimen justifies Yamaguti's opinion.

*Hosts.*—*Clarias batrachus* and *Glossogobius giurus.*

*Location.*—Intestine.

*Locality.*—Manila.

## Family OPECOELIDÆ (Ozaki, 1925) Ozaki, 1928

**OPEGASTER MINIMUS (Tubangui, 1928) comb. nov.**

Synonym: *Opecoelus minimus* Tubangui, 1928.

We agree with Yamaguti (1934) that this fluke should be placed in the genus *Opegaster* Ozaki, 1928. The parasite appears to have a wide range of host tolerance, the collection containing numerous specimens obtained from five different kinds of fishes. Some of the specimens are exceptionally well preserved and show clearly certain structures which unfortunately were either overlooked or not interpreted correctly in the original description of the parasite. For example, the greater part of the vesicula seminalis is not enclosed within the cirrus pouch, but lies free in the parenchyma. The narrow portion of the vesicula seminalis externa near the base of the cirrus sac is surrounded by deeply staining cells. The cirrus pouch is small, pyriform to oval, 0.072 by 0.044 to 0.128 by 0.072 millimeter. A short Laurer's canal is present; it opens on the dorsal surface slightly to one side of the median line at a level in front of the ovary. The proximal portion of the uterus is filled with spermatozoa and probably functions as a receptaculum seminis. In a few specimens the acetabulum shows the presence of six marginal papillæ similar to those reported by Japanese writers in members of the genus *Opegaster.*

Some marked variations in the morphology of the fluke were also seen. The arrangement of the testes may differ so that instead of being tandem, as originally reported, they may be placed obliquely one behind the other. These organs are generally globular or oval, but in many individuals they are 2- to 3-lobed. In several specimens a single globular testis is present. Like the testes, the ovary sometimes show a lobed appearance.

Two specimens have the vesicula seminalis externa extending posteriorly far beyond the posterior border of the acetabulum and reaching almost to the ovary. Other specimens show the vitelline glands reaching far forward and sometimes meeting in the median line in front of the acetabulum.

*Hosts.*—*Glossogobius giurus, Ophicephalus striatus, Therapon argenteus, Clarias batrachus,* and *Arius manillensis.*

*Location.*—Intestine (one specimen is labelled as having been collected from the liver of *Glossogobius*).

*Locality.*—Manila.

## Family AZYGIIDÆ Odhner, 1911

**AZYGIA PRISTIPOMAI Tubangui, 1928.**

One specimen in poor condition is found in the collection. According to Dickerman (1934), this trematode may be placed either in the genus *Azygia* or in the genus *Protometra* depending upon the arrangement of the principal excretory vessels. In the genus *Protometra* the lateral excretory vessels unite anterior to the oral sucker, while in the genus *Azygia* no such union of the vessels takes place. A restudy of the type specimen of the parasite has shown that the arrangement of the excretory system does not conform to that of the genus *Protometra.* The lateral excretory vessels do not unite, anterior to the oral sucker; on reaching the posterior or middle level of the oral sucker each vessel makes a sharp turn towards the posterior end of the body.

*Host.*—*Glossogobius giurus.*

*Location.*—Not stated.

*Locality.*—Manila.

## Family HEMIURIDÆ Luehe, 1901

**ECTENURUS LEMERIENSIS Tubangui and Masiluñgan, 1935.**

This fluke is represented in the collection by one fairly well preserved specimen which is said to have been obtained from a goby. The type host of this parasite is the leather jacket, *Scomberoides* sp.

*Host.*—*Glossogobius giurus.*

*Location.*—Duodenum.

*Locality.*—Manila.

## Family CLINOSTOMIDÆ Luehe, 1901

**CLINOSTOMUM OPHICEPHALI sp. nov. Plate 2, fig. 2.**

This is represented by one specimen obtained from *Ophicephalus striatus*. It constitutes the third species of clinostomid metacercariae to be reported from this fish, the other two being *Clinostomum dalagi* Tubangui, 1933 and *Euclinostomum multicaecum* Tubangui and Masiluñgan, 1935.

*Description.*—Body slipper-shaped, 2.8 millimeters in length by 1.1 millimeters in maximum width across acetabulum. Cuticle armed with numerous minute spines. Oral sucker ventroterminal, 0.27 millimeter across; acetabulum at junction of anterior and middle thirds of body length, 0.40 by 0.54 millimeter. Pharynx apparently absent; oesophagus 0.1 millimeter long; intestinal caeca wavy in outline, with short lateral branches, reach to near posterior end of body.

Testes near posterior end of body, small, tandem, appear as mere transverse lines bent in the middle; anterior testis 0.22, posterior testis 0.20 millimeter across. Cirrus pouch well developed, between ovary and shell gland, 0.17 by 0.065 millimeter, its bulk on right side of median line; incloses small seminal vesicle and short cirrus. Common genital pore median, in front of second testis, about 0.2 millimeter from posterior end of body.

Ovary small, intertesticular, on right side of median line, 0.11 by 0.06 millimeter. Shell gland and ootype complex on left side of median line opposite ovary. Uterine sac median, longitudinal, 0.8 millimeter long, extends from genital pore to about half the distance between acetabulum and anterior testis.

Excretory pore slightly dorsal, near posterior end of body. Excretory bladder small, V-shaped; lateral excretory vessels very prominent, lateral to intestinal caeca.

*Host.*—*Ophicephalus striatus.*

*Location.*—Gall bladder. (This is an unusual location for this type of trematode. Clinostomid metacercariae are ordinarily encysted in the muscles and beneath the skin of their hosts.)

*Locality.*—Manila.

*Type specimen.*—Philippine Bureau of Science parasitological collection No. 662.

This parasite differs from *Clinostomum dalagi* and *C. pseudoheterostomum* which were reported by Tubangui (1933) from

a fish and a frog, respectively, in its small size, the location of the genital glands near the posterior end of the body, and the shape of the testes.

## Family HETEROPHYIDÆ Odhner, 1914

**NEOCHASMUS MICROVATUS (Tubangui, 1928) comb. nov. Plate 1, figs. 2 and 3.**

Synonyms: *Metadena microvata* Tubangui, 1928.
*Metadena ovata* Tubangui and Francisco, 1930.

There are three specimens of this trematode, one of which is in fair condition. It has been noted that the genus *Metadena* Linton, to which the parasite was originally assigned, is given an uncertain status by systematic writers in the scheme of classification of the trematodes due most probably to the scanty knowledge on the morphology of its members. For this reason it was decided to study carefully not only the specimens in the collection but also the type material. As a result, the following taxonomic features that were overlooked in the original description have been found: the presence of small spines around the mouth opening, a voluminous receptaculum seminis, and a genital sinus that is intimately associated with the acetabulum; the submerged position of the acetabulum; and the ventral position of the ovary. These characters together with those already given in the original description place the parasite in the heterophyid genus *Neochasmus* Van Cleave and Mueller, 1932.

The circumoral spines occur in a single row. They can be easily overlooked because of their minute size, the average length being 13.5 microns. They also appear to be easily detached, for of ten specimens examined only two show their presence. One of these two specimens has 7 and the other 16 spines.

The receptaculum seminis, which was mistaken for a part of the seminal vesicle, is voluminous and is dorsally located. In dorsal view, it is seen to occupy most of the space between the intestinal caeca and the testes.

The acetabulum is slightly retracted into the body. It is associated in heterophyid fashion with a small genital sinus, into which the terminal portions of the male and female reproductive organs open. A typical gonotyl cannot be made out, but posterior to the genital pore there is a cuticular thickening which may take the place of a gonotyl.

*Host.*—*Glossogobius giurus.*

*Location.*—Intestine.

*Locality.*—Manila.

## Family MICROSCAPHIDIIDÆ Travassos, 1922

### Synonym: ANGIODICTYIDÆ Looss, 1902

**HEXANGIUM AFFINUM sp. nov. Plate 2, fig. 1.**

This parasite, of which several specimens are available, belongs to a group of trematodes which has been classified by some authors with monostomes because of the presence of only one sucker. According to Odhner (1911), these flukes are really amphistomes in which the acetabulum has disappeared. Travassos (1934) has classified them accordingly and placed them in the family Microscaphidiidae.

*Description.*—Body elongated, 2.7 to 3.0 by 0.8 to 1.0 millimeters, anterior end usually more attenuated than posterior end. Cuticle armed with very fine spines. Oral sucker subterminal, well developed, 0.20 to 0.24 millimeter in diameter; prepharynx 0.40 to 0.46 millimeter long; pharynx poorly developed, 0.12 to 0.15 by 0.12 to 0.17 millimeter; oesophagus very short, practically absent; intestinal caeca large, slightly dilated at their blind ends, reach posteriorly to in front of testes.

Testes globular to oval, near posterior end of body, one usually slightly and obliquely behind the other; they measure 0.24 to 0.26 by 0.24 to 0.30 millimeter. Seminal vesicle a long sinuous canal, free in parenchyma, extends from in front of middle of body length to cirrus sac. The latter is circular in outline, poorly developed, 0.10 to 0.12 millimeter across. Other details of male reproductive system not discernible in available specimens. Common genital pore median to submedian, about midway between oral sucker and intestinal bifurcation.

Ovary median to submedian, immediately posttesticular, in contact with one of testes, globular to slightly oval, 0.10 to 0.12 by 0.10 to 0.16 millimeter, or about half the size of either testis. Shell gland small, behind and dorsal to ovary. Receptaculum seminis and Laurer's canal not discernible. Uterus moderately well developed, confined between intestinal caeca. Vitellaria in distinct, variously shaped follicles, arranged (in extended specimens) in four linear series, one series on each side of caecum; they extend from level of junction of anterior and middle thirds of length of caeca to in front of blind ends of caeca. Vitelline reservoir small, to one side of median line, in front of shell gland. Eggs oval, yellowish, operculated, 80 to 100 by 48 to 57 microns.

Excretory pore dorsal, near posterior end of body. Excretory bladder large, occupies most of space behind ovary; it presents posteriorly a heart-shaped, thick-walled cavity and anteriorly it gives off on each side a conspicuous excretory vessel, the course of which is not discernible.

*Host.*—*Amphacanthus javus.*

*Location.*—Intestine.

*Locality.*—Manila.

*Type specimens.*—Philippine Bureau of Science parasitological collection No. 661.

The host of *Hexangium affinum* is also known as *Siganus javus* and is therefore generically related to *Siganus fuscescens*, the host of *Hexangium sigani* Goto and Ozaki, 1929, the type and heretofore the only species of the genus *Hexangium*. The two parasites are also closely related, but they may be distinguished from each other by their size and the arrangement of their testes. *H. affinum* is smaller, 2.7 to 3.0 by 0.8 to 1.0 millimeters, and its testes are almost symmetrical. *H. sigani*, on the other hand, measures 8.0 to 10.3 by 1.8 to 2.2 millimeters and its testes are almost tandem or at least more centrally placed than those of *H. affinum*.

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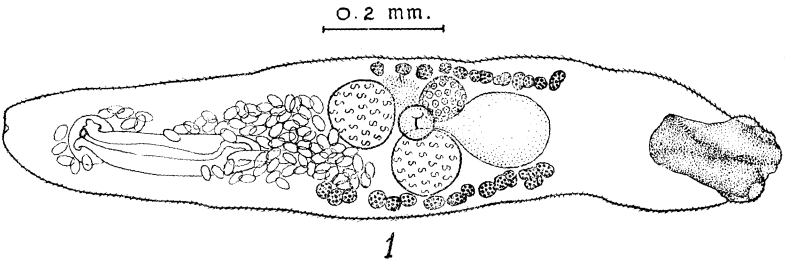
# ILLUSTRATIONS

## PLATE 1

FIG. 1. *Prosorhynchus triangularis* sp. nov., entire worm, ventral view.
2. *Neochasmus microvatus* (Tubangui, 1928), entire worm, ventral view.
3. *Neochasmus microvatus* (Tubangui, 1928), entire worm, lateral view.

## PLATE 2

FIG. 1. *Hexangium affinum* sp. nov., entire worm, ventral view.
2. *Clinostomum ophicephali* sp. nov., entire worm, ventral view.

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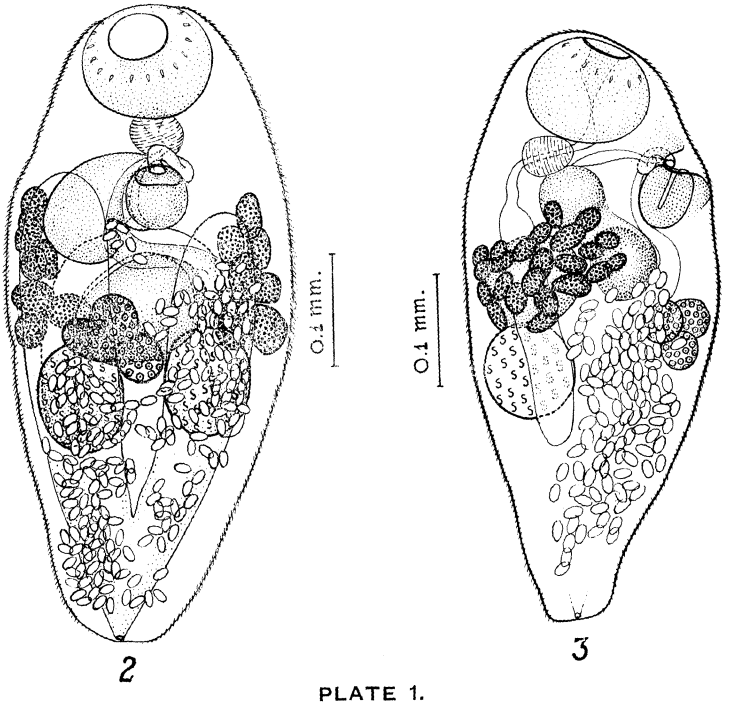


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PLATE 1.

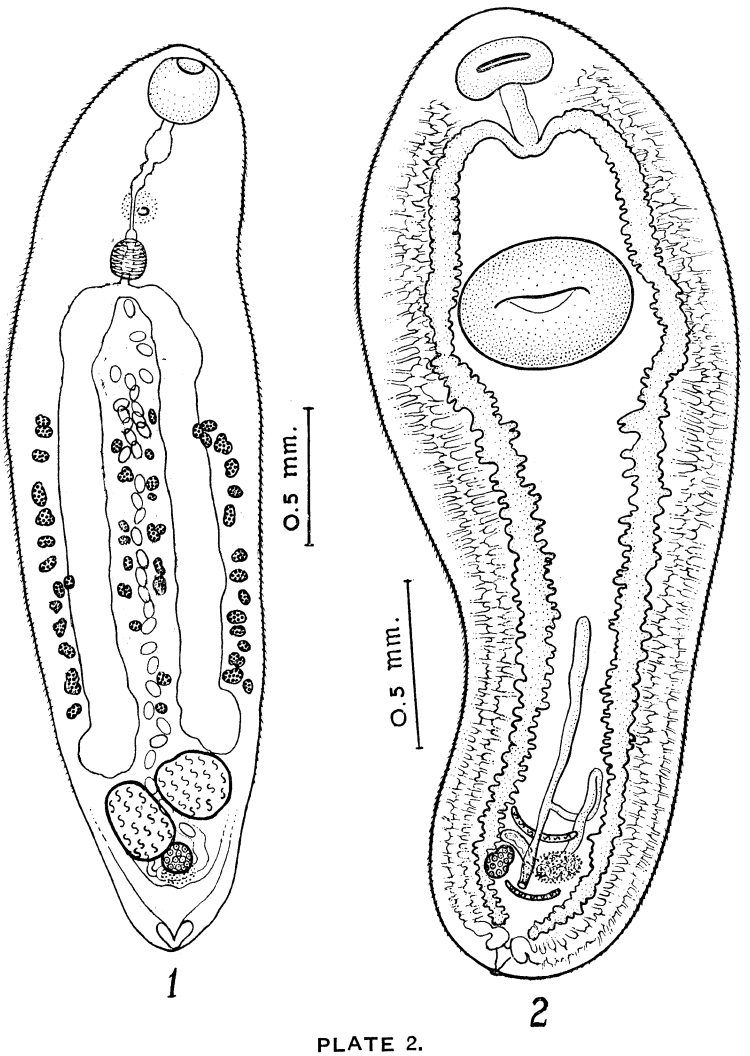


PLATE 2.

VOL. 76, No. 4 APRIL, 1947



# THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1947

6261

# THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Department of Agriculture and Commerce

[Entered at the Post Office at Manila, Philippines, as second-class matter]

THE PHILIPPINE
JOURNAL OF SCIENCE

VOL. 76 APRIL, 1947 No. 4

# A SUMMARY OF THE PARASITIC WORMS REPORTED FROM THE PHILIPPINES [1]

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## INTRODUCTION

As far as can be ascertained, the first parasitic worms reported from the Philippines were the nematodes *Auchenacantha corollata* (Schneider, 1866) and *Gnathostoma spinigerum* Owen, 1836, found in the digestive tracts of the flying lemur and the palm civet, respectively. They were both described by Schneider in 1866 under the names *Oxyuris corollatus* and *Filaria radula*, respectively. From that time to 1946, 336 species of helminths were recorded, of which 126 species were trematodes, 54 cestodes, 138 nematodes, 2 Gordiacea and 16 Acanthocephala. These worms were obtained from different kinds of animal hosts representing 18 species of mammals, 51 birds, 10 reptiles, 2 amphibians, 29 fishes, 9 arthropods, and 8 snails.

The greater part of the present Summary had been written before the library of the Bureau of Science and the other scientific libraries in Manila were destroyed in February, 1945, as a result of the war. It was intended to serve as a convenient source of information for those interested in Philippine helminths. Although its usefulness for local workers has been lessened temporarily, because of the present lack of reference facilities, yet it is believed that it will still be of aid in taxonomic and biologic investigations.

The following information is given for each species of parasite: (*a*) the best available scientific name; (*b*) synonyms, if

[1] The author wishes to express his appreciation and thanks to Misses Victoria A. Masilungan and Magna de Guzman for their invaluable assistance in the preparation of the list of references.

any; (*c*) location in the (*d*) definitive host or hosts; (*e*) intermediate host or hosts, if any and if the life history is known; (*f*) geographical distribution; and (*g*) references. In order to save space, the latter are indicated by numerals to be used in conjunction with the numbered list of references given at the end of the Summary. Except in rare instances, only papers in which Philippine material is discussed are included in the list of references. Other pertinent information may be found in these papers.

The zoölogical names of the vertebrate hosts, except those of the birds, have been adopted from the following publications: A Check List of Philippine Fishes, by H. A. Roxas and C. Martin (1937); Amphibians and Turtles of the Philippine Islands, by E. H. Taylor (1921); The Lizards of the Philippine Islands, by E. H. Taylor (1922); The Snakes of the Philippine Islands, by E. H. Taylor (1922); and Philippine Land Mammals, by E. H. Taylor (1934). The names of the birds are according to A Manual of Philippine Birds, by R. C. McGregor (1909), and to the latest available literature kindly supplied by Dr. Canuto G. Manuel, of the Division of Natural History Museum, Department of Agriculture and Commerce.

## Phylum PLATYHELMINTHES Claus; 1885

## Class TREMATODA Rudolphi, 1808

### Subclass MONOGENEA Carus, 1863

#### Order MONOPISTHOCOTYLEA Odhner, 1912

#### Superfamily GYRODACTYLOIDEA Johnson and Tiegs, 1922

#### Family DACTYLOGYRIDÆ Bychowsky, 1933

##### Subfamily TETRAONCHINÆ Monticelli, 1903

###### Genus ANCYROCEPHALUS Creplin, 1839

**ANCYROCEPHALUS MANILENSIS Tubangui, 1931.**

Gills of marine fishes (*Amphacanthus virgatus, Anyperodon leucogrammicus* and *Lutjanus* sp.). Manila, Luzon.

Reference: 181.

###### Genus TETRANCISTRUM Goto and Kikuchi, 1917

**TETRANCISTRUM LUTIANI Tubangui, 1931.**

Gills of marine fish (*Lutjanus* sp.). Manila, Luzon.

Reference: 181.

## Order POLYOPISTHOCOTYLEA Odhner, 1912

### Superfamily DICLIPHOROIDEA Price, 1936

### Family MICROCOTYLIDÆ Taschenberg, 1879

#### Subfamily MICROCOTYLINÆ Monticelli, 1892

##### Genus MICROCOTYLE van Beneden and Hesse, 1863

**MICROCOTYLE VIRGATARUM Tubangui, 1931.**

Gills of marine fish (*Amphacanthus virgatus*). Manila, Luzon.

Reference: 181.

## Subclass DIGENEA Carus, 1863

## Order GASTEROSTOMATA Odhner, 1905

### Family BUCEPHALIDÆ Poche, 1907

#### Subfamily PROSORHYNCHINÆ Nicoll, 1914

##### Genus PROSORHYNCHUS Odhner, 1905

**PROSORHYNCHUS TRIANGULARIS Tubangui and Masilungan, 1944.**

Intestine of fresh-water fish (*Glossogobius giurus*). Manila, Luzon.

Reference: 206.

## Order PROSOSTOMATA Ohdner, 1905

### Suborder MONOSTOMATA Zeder, 1800

### Family CYCLOCOELIIDÆ Kossack, 1911

#### Subfamily CYCLOCOELIINÆ Stossich, 1902

##### Genus CYCLOCOELIUM Brandes, 1892

###### Subgenus POSTPHARYNGEUM Witenberg, 1926

**CYCLOCOELIUM (POSTPHARYNGEUM) ORIENTALE var. EURHINA Tubangui, 1932.**

*Cyclocoelium* (*Postpharyngeum*) *obscurum* (Leidy, 1887) of TUBANGUI, 1933.

Cervical air sac of bird (*Tringa totanus eurhinus*). Obando, Bulacan, Luzon.

References: 183, 187.

### Family NOTOCOTYLIDÆ Luehe, 1909

#### Subfamily NOTOCOTYLINÆ Kossack, 1911

##### Genus NOTOCOTYLUS Diesing, 1839

**NOTOCOTYLUS INTESTINALIS Tubangui, 1932.**

Intestine of domestic duck and chicken. Manila and Pateros, Rizal; Luzon.

References: 183, 205.

**NOTOCOTYLUS NAVIFORMIS Tubangui, 1932.**

Intestine of domestic duck. Pateros, Rizal, Luzon.

Reference: 183.

## Family OPISTHOTREMATIDÆ Poche, 1926

### Genus OPISTHOTREMA Fischer, 1883

**OPISTHOTREMA DUJONIS (Leuckart, 1874) Price, 1932.**

*Monostomum dujonis* LEUCKART, 1874.

*Opisthotrema cochleare* FISCHER, 1883.

Eustachian tube and œsophagus of dugong (*Halicore dugong*). Exact locality not specified.

References: 57, 94, 124.

## Family EUCOTYLIDÆ Skrjabin, 1924

### Genus TAMERLANIA Skrjabin, 1924

**TAMERLANIA BRAGAI Dos Santos, 1934.**

Urinary tract (?) of domestic pigeon. Manila, Luzon.

Reference: 205.

# Suborder STRIGEATA La Rue, 1926

## Superfamily STRIGEOIDEA Railliet, 1919

## Family STRIGEIDÆ (Railliet, 1919)

### Subfamily STRIGEINÆ Railliet, 1919

### Genus STRIGEA Abildgaard, 1790

**STRIGEA MCGREGORI Tubangui, 1932.**

Intestine of bird (*Butastur indicus*). Calamba, Laguna, Luzon.

Reference: 183.

### Genus PARASTRIGEA Szidat, 1928

**PARASTRIGEA INTERMEDIA Tubangui, 1932.**

Intestine of bird (*Butastur indicus*). Calamba, Laguna, Luzon.

Reference: 183.

### Genus PSEUDAPATEMON Dubois, 1936

**PSEUDAPATEMON MAMILLIFORMIS (Tubangui, 1932) Dubois, 1936.**

*Cotylurus mamilliformis* TUBANGUI, 1932.

Intestine of bird (*Capella gallinago gallinago*). Calamba, Laguna, Luzon.

References: 51, 183.

IMMATURE FORM

**TETRACOTYLE BICOLANDIAE Tubangui, 1933.**

Encysted in cervical subcutaneous tissues of bird (*Sterna albitrons sinensis*). Iriga, Camarines Sur, Luzon.

Reference: 187.

## Family DIPLOSTOMATIDÆ Poirier, 1886

### Subfamily DIPLOSTOMATINÆ Monticelli, 1888

#### Genus NEODIPLOSTOMUM Railliet, 1919

**NEODIPLOSTOMUM ALUCONIS Tubangui, 1933.**

Small intestine of bird (*Aluco longimembris*). Obando, Bulacan, Luzon.

Reference: 187.

**NEODIPLOSTOMUM BUTASTURINUM (Tubangui, 1932) Dubois, 1936.**

*Proalaria butasturina* TUBANGUI, 1932.

Small intestine of bird (*Butastur indicus*). Calamba, Laguna, Luzon.

References: 51, 183.

#### Genus POSTHODIPLOSTOMUM Dubois, 1938

**POSTHODIPLOSTOMUM LARAI (Refuerzo and Garcia, 1937) Dubois, 1938.**

*Neodiplostomum larai* REFUERZO and GARCIA, 1937.

Small intestine of bird (*Bubulcus ibis coromandus*). Laguna de Bay, Laguna, Luzon.

References: 51a, 131.

## Family CYATHOCOTYLIDÆ Poche, 1925

### Subfamily PROHEMISTOMATINÆ Lutz, 1935

#### Genus MESOSTEPHANUS Lutz, 1935

**MESOSTEPHANUS FREGATUS Tubangui and Masilungan, 1941.**

Small intestine of bird (*Fregatus ariel ariel*). Obando, Bulacan, Luzon.

Reference: 205.

**MESOSTEPHANUS HALIASTURUS Tubangui and Masilungan, 1941.**

Small intestine of bird (*Haliastur indus intermedius*). Pampanga Province, Luzon.

Reference: 205.

## Family PROTERODIPLOSTOMATIDÆ Dubois, 1936

### Subfamily PROTERODIPLOSTOMATINÆ Dubois, 1936

#### Genus PSEUDONEODIPLOSTOMUM Dubois, 1936

**PSEUDONEODIPLOSTOMUM CROCODILARUM (Tubangui and Masilungan, 1936) comb. nov.**

*Neodiplostomum crocodilarum* TUBANGUI and MASILUNGAN, 1936.

Intestine of crocodile (*Crocodilus porosus*). Palawan.
References: 51, 199.

## Superfamily CLINOSTOMATOIDEA Dollfus, 1931

## Family CLINOSTOMATIDÆ (Luehe, 1901) Odhner, 1902

### Subfamily CLINOSTOMATINÆ Odhner, 1902

#### Genus CLINOSTOMUM Leidy, 1856, nec Girard, 1856

**CLINOSTOMUM ABDONI Tubangui and Garcia, 1939.**

Under tongue of domestic cat. Surigao, Surigao, Mindanao.
Reference: 197.

**CLINOSTOMUM DALAGI Tubangui, 1933.**

Encysted in eye sockets and pericardium of fresh-water fish (*Ophicephalus striatus*). Los Baños, Laguna, Luzon.
Reference: 187.

**CLINOSTOMUM OPHICEPHALI Tubangui and Masilungan, 1944.**

Gall bladder (?) of fresh-water fish (*Ophicephalus striatus*). Manila, Luzon.
Reference: 206.

**CLINOSTOMUM PSEUDOHETEROSTOMUM Tubangui, 1933.**

Encysted between femoral muscles of frog (*Rana magna*). Los Baños, Laguna, Luzon.
Reference: 187.

#### Genus EUCLINOSTOMUM Travassos, 1928

**EUCLINOSTOMUM MULTICAECUM Tubangui and Masilungan, 1935.**

Encysted in muscles of fresh-water fish (*Ophicephalus striatus*). Baao, Camarines Sur, Luzon.
Reference: 198.

## Superfamily SCHISTOSOMATOIDEA Stiles and Hassall, 1926

## Family SCHISTOSOMATIDÆ Looss, 1899

### Subfamily SCHISTOSOMATINÆ Stiles and Hassall, 1898

#### Genus SCHISTOSOMA Weinland, 1858

**SCHISTOSOMA JAPONICUM Katsurada, 1904.**

*Schistosoma cattoi* R. BLANCHARD, 1905.

Portal and mesenteric veins of man, cat, dog, pig, cattle, goat, horse and wild rats; also, experimentally, guinea pig,

white rat, mouse and monkey. Molluscan intermediate host, *Oncomelania quadrasi*. Mindoro, Leyte, Samar, and Mindanao.

References: 8, 15, 17, 31a, 48, 49a, 55a, 56a, 56b, 60, 62a, 65, 80, 80a, 80b, 80c, 82, 88b, 98a, 98b, 98c, 109, 110, 117, 119, 126, 127, 135, 159, 165a, 168a, 169, 185, 199a, 209, 232, 236, 236a.

Genus **AUSTROBILHARZIA** Johnston, 1917

**AUSTROBILHARZIA BAYENSIS** Tubangui, 1933.

Mesenteric vein of bird (*Capella gallinago gallinago*). Bay, Laguna, Luzon.

Reference: 187.

## Suborder AMPHISTOMATA (Rudolphi, 1801) Bojanus, 1817

### Superfamily PARAMPHISTOMATOIDEA Stiles and Goldberger, 1910

### Family PARAMPHISTOMATIDÆ (Fischoeder, 1901)

Subfamily PARAMPHISTOMATINÆ Fischoeder, 1901

Genus **PARAMPHISTOMUM** Fischoeder, 1901

**PARAMPHISTOMUM ANISOCOTYLEA** Faust, 1920.

Rumen of cattle and carabao. Manila, Luzon.

References: 55, 88, 150, 174.

**PARAMPHISTOMUM CERVI** (Schrank, 1790).

Rumen and bile ducts of cattle. Presumably widely distributed.

Reference: 88.

**PARAMPHISTOMUM EXPLANATUM** (Creplin, 1847).

*Paramphistomum cervi* (Zeder, 1790) of TUBANGUI, 1925.

Rumen of cattle and carabao. Manila and Laguna, Luzon.

References: 88, 150, 174, 187.

**PARAMPHISTOMUM** sp. Boynton and Wharton, 1916.

Stomach of cow. Minalabag, Camarines Sur, Luzon.

Reference: 38.

Genus **COTYLOPHORON** Stiles and Goldberger, 1910

**COTYLOPHORON COTYLOPHORUM** (Fischoeder, 1901).

Rumen of cattle and carabao. Widely distributed.

References: 88, 150, 174.

### Family GASTROTHYLACIDÆ Stiles and Goldberger, 1910

Subfamily GASTROTHYLACINÆ Stiles and Goldberger, 1910

Genus **GASTROTHYLAX** Poirier, 1883

**GASTROTHYLAX CRUMENIFER** (Creplin, 1847).

Rumen of cattle and carabao. Manila, Luzon.

References: 88, 150.

Genus CARMYERIUS Stiles and Goldberger, 1910

**CARMYERIUS GREGARIUS (Looss, 1896).**

Rumen and reticulum of cattle and carabao. Manila, Luzon.
References: 88, 174.

Genus FISCHOEDERIUS Stiles and Goldberger, 1910

**FISCHOEDERIUS ELONGATUS (Poirier, 1883).**

Rumen of cattle and carabao. Widely distributed.
References: 88, 150, 174.

Subfamily DIPLODISCINÆ Cohn, 1904

Genus DIPLODISCUS Diesing, 1836

**DIPLODISCUS AMPHICHRUS Tubangui, 1933.**

Small intestine and rectum of frog (*Rana vittigera*). Los Baños, Laguna, and Novaliches, Rizal; Luzon.
References: 172, 187.

Family GASTRODISCIDÆ Stiles and Goldberger, 1910

Genus GASTRODISCOIDES Leiper, 1913

**GASTRODISCOIDES HOMINIS (Lewis and McConnell, 1876).**

*Gastrodiscus hominis* of TUTTLE, 1910.

Intestine of man. Cotabato, Mindanao.
Reference: 212a.

Genus HOMALOGASTER Poirier, 1883

**HOMALOGASTER PALONIAE Poirier, 1883.**

*Homalogaster philippinensis* STILES and GOLDBERGER, 1908.

Caecum of cattle. Manila, Luzon.
References: 88, 105, 150, 160, 161, 172, 174.

Family MICROSCAPHIDIIDÆ Travassos, 1922

Genus HEXANGIUM Goto and Ozaki, 1929

**HEXANGIUM AFFINUM Tubangui and Masilungan, 1944.**

Intestine of fish (*Amphacanthus javus*). Manila, Luzon.
Reference: 206.

## Suborder DISTOMATA Zeder, 1800

### Superfamily FASCIOLOIDEA Stiles and Goldberger, 1910

Family FASCIOLIDÆ Railliet, 1895

Subfamily FASCIOLINÆ Stiles and Hassall, 1898

Genus FASCIOLA Linnæus, 1758

**FASCIOLA GIGANTICA Cobbold, 1856.**

Bile ducts of cattle, carabao, sheep, goat; also man (?). Snail intermediate hosts: *Lymnaea philippinensis* and *L. swin-*

*hoe* var. *quadrasi;* also *Mixas cumingiana* (?). Probably widely distributed.

References: 26, 49a, 55, 88, 104, 112, 148, 150, 174.

**FASCIOLA HEPATICA** Linnæus, 1758.

*Distomum hepaticum* RETZIUS, 1786.
*Fasciola humana* GMELIN, 1790.

Bile ducts of cattle, carabao, sheep, goat; also man (?). Snail intermediate host: *Lymnaea philippinensis.* Widely distributed.

References: 26, 49a, 87, 88, 112, 127, 137, 148, 150, 172b, 174.

Subfamily FASCIOLOPSINÆ Odhner, 1911

Genus **FASCIOLOPSIS** Looss, 1899

**FASCIOLOPSIS BUSKI** (Lankester, 1857).

Presumably small intestine of man (Chinese). Jolo, Sulu Archipelago.

References: 26, 66a, 145a, 148, 174, 187.

**FASCIOLOPSIS** sp. Garrison, 1910.

Presumably intestine of cattle (*Bos*). Manila (?), Luzon.

References: 66a, 88, 174.

## Superfamily ECHINOSTOMATOIDEA (Faust, 1929)

### Family ECHINOSTOMATIDÆ Looss, 1902

Subfamily ECHINOSTOMATINÆ Looss, 1899

Genus **ECHINOSTOMA** (Rudolphi, 1809) Dietz, 1910

**ECHINOSTOMA BATANGUENSIS** Tubangui, 1932.

Small intestine of bird (*Gallinula chloropus lozanoi*). Batangas, Batangas, Luzon.

Reference: 183.

**ECHINOSTOMA CHARADRII** Tubangui and Masilungan, 1935.

Intestine of bird (*Pluvialis dominica fulva*). Baao, Camarines Sur, Luzon.

Reference: 198.

**ECHINOSTOMA CHLOROPODIS** var. **PHILIPPINENSIS** Tubangui, 1932.

Small intestine of bird (*Gallinula chloropus lozanoi*). Los Baños, Laguna, Luzon.

Reference: 183.

**ECHINOSTOMA GUERREROI** (Tubangui, 1931) comb. nov.

*Euparyphium guerreroi* TUBANGUI, 1931.

Small intestine of rat (*Rattus norvegicus*). Manila, Luzon.

References: 179, 182.

**ECHINOSTOMA ILOCANUM (Garrison, 1908) Odhner, 1911.**

*Fascioletta ilocana* GARRISON, 1908.
*Euparyphium ilocanum* (Garrison, 1908) TUBANGUI, 1931.

Small intestine of man and rat (*Rattus norvegicus*). First snail intermediate host: *Anisus* (*Gyraulus*) *convexiusculus;* second intermediate hosts: *Pila luzonica* and other fresh-water snails. Northwestern Luzon, including Manila and Zambales Province; Mindoro; Leyte and Mindanao.

References: 49a, 59, 66, 79, 117b, 127, 179, 182, 208.

**ECHINOSTOMA MURINUM (Tubangui, 1931) comb. nov.**

*Euparyphium murinum* TUBANGUI, 1931.

Small intestine of rat (*Rattus norvegicus*). First and second snail intermediate hosts: *Lymnaea* (*Radix*) *swinhoe* var. *quadrasi.* Manila and Baguio, Luzon.

References: 182, 184.

**ECHINOSTOMA REVOLUTUM (Froelich, 1802) Dietz, 1909.**

Small intestine and cæcum of domestic duck and chicken. First and second snail intermediate hosts: *Lymnaea* (*Radix*) *swinhoe* var. *quadrasi.* Pateros, Rizal; Manila and Baguio, Luzon.

References: 183, 184, 205.

**Genus NEPHROSTOMUM Dietz, 1909**

**NEPHROSTOMUM BICOLANUM Tubangui, 1933.**

Small intestine of birds (*Herodias timoriensis* and *Bubulcus ibis coromandus*). Iriga, Camarines Sur, Luzon; Palo, Leyte.

Reference: 187.

**Genus ECHINOPARYPHIUM Dietz, 1909**

**ECHINOPARYPHIUM RECURVATUM (von Linstow, 1873).**

Small intestine of domestic duck. Pateros, Rizal, Luzon.

Reference: 183.

**Subfamily HIMASTHLINÆ Odhner, 1911**

**Genus ACANTHOPARYPHIUM Dietz, 1909**

**ACANTHOPARYPHIUM OCHTHODROMI Tubangui, 1933.**

Small intestine of bird (*Ochthodromus mongolus mongolus*). Palo, Leyte.

Reference: 187.

Subfamily ECHINOCHASMINÆ Odhner, 1911

Genus ECHINOCHASMUS Dietz, 1909

**ECHINOCHASMUS NOVALICHESENSIS Tubangui, 1932.**

Small intestine of bird (*Rallus torquatus torquatus*). Metacercaria in fishes (*Glossogobius giurus, Therapon plumbeus* and *Ophiocara aporos*). Manila and Novaliches, Rizal; Luzon.

References: 183, 214.

Genus EPISTHMIUM Luehe, 1909

**EPISTHMIUM GALLINUM Tubangui and Masilungan, 1941.**

Bursa Fabricii of domestic chicken. Manila, Luzon.

Reference: 205.

SUBFAMILY UNCERTAIN

Genus PEGOSOMUM von Ratz, 1903

**PEGOSOMUM BUBULCUM Tubangui and Masilungan, 1935.**

Liver of bird (*Bubulcus ibis coromandus*). Baao, Camarines Sur, Luzon.

Reference: 198.

## Superfamily DICROCOELIOIDEA (Faust, 1929)

## Family DICROCOELIIDÆ Odhner, 1911

Subfamily DICROCOELIINÆ Looss, 1899

Genus DICROCOELIUM (Dujardin, 1845)

**DICROCOELIUM DENDRITICUM (Rudolphi, 1818).**

*Dicrocoelium lanceolatum* (RUDOLPHI, 1803).
*Dicrocoelium lanceatum* STILES and HASSALL, 1896.

Presumably bile ducts of *Bos* (*taurus* ?). Manila (?), Luzon.

References: 66a, 88, 174.

Genus EURYTREMA Looss, 1907

**EURYTREMA OVIS Tubangui, 1925.**

Pancreatic duct and fat surrounding rectum of sheep; pancreatic duct and gall bladder of cattle. Manila and Batangas Province, Luzon.

References: 32a, 88, 174, 221.

Genus PLATYNOSOMUM Nicoll, 1914

**PLATYNOSOMUM PHILIPPINORUM Tubangui, 1928.**

Small intestine of bat (*Scotophilus temminckii*). Los Baños, Laguna, Luzon.

Reference: 177.

Genus **PARADISTOMUM** Kossack, 1910

**PARADISTOMUM EXCALOTES** Tubangui and Masilungan, 1935.

Gall bladder of lizard (*Calotes marmoratus*). San Juan, Rizal, Luzon.

Reference: 198.

**PARADISTOMUM GREGARINUM** Tubangui, 1929.

*Paradistomum magnum* TUBANGUI, 1928.

Gall bladder of lizard (*Hemidactylus frenatus*). Los Baños, Laguna, Luzon.

References: 177, 178.

**PARADISTOMUM PALOENSIS** Tubangui, 1933.

Gall bladder of lizard (*Hydrosaurus pustulosus*). Palo, Leyte.

Reference: 187.

Genus **EUPARADISTOMUM** Tubangui, 1931

**EUPARADISTOMUM VARANI** Tubangui, 1931.

Gall bladder of monitor (*Varanus salvator*). Los Baños, Laguna, Luzon.

Reference: 180.

Genus **MESOCOELIUM** Odhner, 1911

**MESOCOELIUM MEGGITTI** Bhalerao, 1927.

Intestine of lizard (*Mabuya multifasciata*). Los Baños, Laguna, Luzon.

Reference: 180.

## Family ALLOCREADIIDÆ (Stossich, 1904)

### Subfamily ALLOCREADIINÆ Looss, 1902

Genus **ORIENTOCREADIUM** Tubangui, 1931

**ORIENTOCREADIUM BATRACHOIDES** Tubangui, 1931.

Intestine of fresh-water fish (*Clarias batrachus*). Laguna de Bay, Los Baños, Laguna, Luzon.

References: 180, 206.

## Family PLAGIORCHIIDÆ Luehe, 1901

### Subfamily PLAGIORCHIINÆ Pratt, 1902

Genus **PLAGIORCHIS** Luehe, 1899

**PLAGIORCHIS PHILIPPINENSIS** Sandground, 1940.

*Lepoderma* LOOSS, 1899 of AFRICA and GARCIA, 1935.
*Plagiorchis* LUEHE, 1899 of AFRICA and GARCIA, 1935.
*Plagiorchis* sp. AFRICA and GARCIA, 1937.

Small intestine of man. Ilocos Sur Province, Luzon.

References: 10, 14, 19, 26, 139.

Genus PLAGIORCHOIDES Olsen, 1937
(= NEOLEPODERMA Mehra, 1937)

PLAGIORCHOIDES POTAMONIDES Tubangui, 1946.

Gall bladder and bile ducts of experimental white rat. Metacercaria in fresh-water crab, *Parathelphusa* (*Barythelphusa*) *mistio*. Naga, Camarines Sur, Luzon.

Reference: 192.

Genus GLYPTHELMINS Stafford, 1905

GLYPTHELMINS STAFFORDI Tubangui, 1928.

Intestine of frog (*Rana vittigera*). Los Baños, Laguna, Luzon.

References: 94a, 94b, 118, 177.

Subfamily STYPHLOTREMATINÆ Baer, 1924

Genus STYPHLODORA Looss, 1899

STYPHLODORA RENALIS Tubangui, 1933.

Kidney of snake (*Python reticulatus*). Manila, Luzon.

Reference: 187.

Subfamily TELORCHIINÆ Looss, 1899

Genus CERCORCHIS Luehe, 1909

CERCORCHIS CYCLEMIDIS Tubangui, 1933.

Intestine of turtle (*Cyclemis amboinensis*). Novaliches, Rizal, Luzon.

Reference: 187.

Subfamily PROSTHOGONIMINÆ Luehe, 1909

Genus PROSTHOGONIMUS Luehe, 1899

PROSTHOGONIMUS CUNEATUS (Rudolphi, 1809).

Bursa Fabricii of domestic chicken. Manila, Luzon.

Reference: 205.

PROSTHOGONIMUS PSEUDOPELLUCIDUS Tubangui and Masiluñgan, 1941.

Bursa Fabricii of domestic chicken. Manila, Luzon.

Reference: 205.

## Superfamily HETEROPHYOIDEA (Faust, 1929)

## Family HETEROPHYIDÆ Odhner, 1914

Subfamily HETEROPHYINÆ Ciurea, 1924

Genus HETEROPHYOPSIS Tubangui and Africa, 1938

HETEROPHYOPSIS EXPECTANS (Africa and Garcia, 1935) Tubangui and Africa, 1937.

*Heterophyes expectans* AFRICA and GARCIA, 1935.
*Heterophyopsis continuus* (Onji and Nishio, 1924) PRICE, 1940.

Small intestine of dog, cat and bird (*Fregata ariel ariel*). Metacercaria in marine fishes (*Gerris kapas, G. filamentosus,*

*Pelates quadrilineatus, Ambassis buruensis, Hemiramphus georgii* and *Mugil* sp.). Manila and Obando, Bulacan; Luzon.
References: 10, 125, 127, 130, 193, 213, 214.

### Genus GALACTOSOMUM Looss, 1899

**GALACTOSOMUM ANGUILLARUM (Tubangui, 1933) Tubangui and Africa, 1938.**
*Haplorchis anguillarum* TUBANGUI, 1933.

Intestine of eel (*Anguilla mauritiana*). Palo, Leyte.
References: 43, 187, 193.

### Genus DIORCHITREMA Witenberg, 1929

**DIORCHITREMA PSEUDOCIRRATA Witenberg, 1929.**

Intestine of man, dog and cat. Metacercaria in fishes (*Anabas testudineus* and *Mugil* sp.). Manila, Luzon.
References: 10, 19, 23, 26, 49a, 127, 130, 213, 214, 215.

### Genus STICTODORA Looss, 1899

**STICTODORA GUERREROI Garcia and Refuerzo, 1936.**

Small intestine of cat, dog and bird (*Larus ridibundus*). Metacercaria in fishes (*Ambassis buruensis* and *Hemiramphus georgii*). Biñan, Laguna, Luzon.
References: 62, 127, 213, 214, 215.

**STICTODORA MANILENSIS Africa and Garcia, 1935.**

Small intestine of cat, dog and bird (*Larus ridibundus*). Metacercaria in fishes (*Ambassis buruensis, Gerris filamentosus* and *Pelates quadrilineatus*). Manila, Luzon.
References: 10, 20, 127, 130, 212b, 213, 214, 215.

**STICTODORA PALMIFERA Vasquez-Colet, 1943.**

Presumably small intestine of dog (experimental infection). Metacercaria in fish (*Sillago maculata*). Manila, Luzon.
Reference: 212b.

**STICTODORA SAWAKINENSIS Looss, 1899.**

Small intestine of cat and dog. Manila, Luzon.
References: 62, 127, 130.

### Genus MICROLISTRUM Braun, 1901

**MICROLISTRUM sp. Vasquez-Colet and Africa, 1938.**

Intestine of cat (experimental infection). Metacercaria in fish (*Ambassis buruensis*). Manila, Luzon.
Reference: 213.

### Genus APOPHALLUS Luehe, 1909

**APOPHALLUS ECCENTRICUS Africa and Garcia, 1935.**

Small intestine of dog. Biñan, Laguna, Luzon.
References: 11, 127, 130.

Subfamily CENTROCESTINÆ Looss, 1899

Genus CENTROCESTUS Looss, 1899

**CENTROCESTUS FORMOSANUS** (Nishigori, 1924).

*Stamnosoma formosanum* NISHIGORI, 1924.

Intestine of birds (*Bubulcus ibis coromandus* and *Ardea purpurea manilensis*); also cat and dog (experimental infections). Metacercaria in fishes (*Anabas testudineus, Glossogobius giurus, Ophicephalus striatus* and *Therapon plumbeus*). Manila, Luzon.

References: 213, 214, 215.

Genus PYGIDIOPSIS Looss, 1907

**PYGIDIOPSIS GENATA** Looss, 1907.

Intestine of cat and dog (experimental infections). Metacercaria in fish (*Mugil* sp.). Manila, Luzon.

Reference: 213.

**PYGIDIOPSIS MARIVILLAI** Refuerzo and Garcia, 1937.

Intestine of bird (*Haliætus leucogaster*) and dog (experimental infection). Metacercaria in fish (*Mugil* sp.). Manila, Luzon.

References: 132, 213.

Genus PHAGICOLA Faust, 1920

**PHAGICOLA PITHECOPHAGICOLA** Faust, 1920.

*Ascocotyle pithecophagicola* (Faust, 1920) FAUST and NISHIGORI, 1926.
*Parascocotyle pithecophagicola* (Faust, 1920) WITENBERG, 1929.
*Ascocotyle (Phagicola) pithecophagicola* (Faust, 1920) TRAVASSOS, 1930.

Intestine of monkey-eating eagle (*Pithecophaga jefferyi*). Exact locality not specified.

References: 55, 56, 123, 170, 233, 234.

Subfamily CERCARIOIDINÆ Witenberg, 1929

Genus SCAPHANOCEPHALUS Jaegerskioeld, 1903

**SCAPHANOCEPHALUS ADAMSI** Tubangui, 1933.

Immature; encysted in fins and under scales of fish (*Lepidaplois mesothorax*). Manila, Luzon.

Reference: 187.

Subfamily HAPLORCHIINÆ Looss, 1899

Genus HAPLORCHIS Looss, 1899

**HAPLORCHIS CALDERONI** (Africa and Garcia, 1935) Africa, 1938.

*Monorchotrema calderoni* AFRICA and GARCIA, 1935.

Small intestine of cat, dog and man. Metacercaria in fishes (*Ophicephalus striatus, Glossogobius giurus, Gerris filamentosus,*

*Creisson validus, Amphacanthus javus, Pelates quadrilineatus, Eleutheronema tetradactyla, Hemiramphus georgii, Ambassis buruensis, Atherina balabacensis* and *Mugil* sp.). Biñan, Laguna, Luzon. (Note: This trematode has been placed by Price [1940] in the genus *Procerovum* of the subfamily Stellantchasminae.)

References: 5, 11, 26, 49a, 125, 127, 130.

**HAPLORCHIS PUMILIO (Looss, 1896) Looss, 1899.**

*Monorchotrema taihokui* NISHIGORI, 1924.

Small intestine of cat and dog (experimental infections). Metacercaria in fishes (*Ophicephalus striatus, Glossogobius giurus, Therapon plumbeus, Gerris filamentosus, Amphacanthus javus* and *Ambassis buruensis*). Manila, Luzon.

References: 5, 26, 127, 130, 214.

**HAPLORCHIS SISONI Africa, 1938.**

Small intestine of cat and dog (experimental infections). Metacercaria in fish (*Therapon plumbeus*). Manila, Luzon.

References: 5, 214, 215.

**HAPLORCHIS TAICHUI (Nishigori, 1924) Chen, 1936.**

*Monorchotrema taichui* NISHIGORI, 1924.

Small intestine of man, cat, dog and bird (*Bubulcus ibis coromandus*). Metacercaria in fresh-water fish (*Ophicephalus striatus*). Manila, Luzon; Leyte.

References: 5, 10, 19, 21, 23, 26, 49a, 127, 130, 214.

**HAPLORCHIS VANISSIMA Africa, 1938.**

Small intestine of man. Bohol.

References: 5, 26.

**HAPLORCHIS YOKOGAWAI (Katsuta, 1932) Chen, 1936.**

*Monorchotrema yokogawai* KATSUTA, 1932.

*Monorchotrema taihokui* NISHIGORI, 1924 of AFRICA and GARCIA, 1935.

Small intestine of man, cat, dog and bird (*Bubulcus ibis coromandus*); also other birds (*Strix whiteheadi* and *Ardea purpurea manilensis*) and monkey (*Pithecus philippinensis*) (experimental infections). Metacercaria in fishes (*Ophicephalus striatus, Gerris kapas, Amphacanthus javus, Ambassis buruensis, Hemiramphus georgii* and *Mugil* sp.). Manila, Luzon.

References: 4, 5, 6, 10, 19, 21, 22, 23, 24, 25, 26, 49a, 127, 130, 213, 214, 215.

Subfamily NEOCHASMINÆ Van Cleave and Mueller, 1932

Genus NEOCHASMUS Van Cleave and Mueller, 1932

**NEOCHASMUS MICROVATUS (Tubangui, 1928) Tubangui and Masiluñgan, 1944.**

*Metadena microvata* TUBANGUI, 1928.

*Metadena ovata* TUBANGUI and FRANCISCO, 1930.

Intestine of fresh-water fish (*Glossogobius giurus*). Manila and Los Baños, Laguna; Luzon.

References: 177, 196, 206.

## Family MICROPHALLIDÆ Travassos, 1921

Genus SPELOTREMA (Jaegerskioeld, 1901) Rankin, 1940

**SPELOTREMA BREVICAECA (Africa and Garcia, 1935) Tubangui and Africa, 1938.**

*Heterophyes brevicaeca* AFRICA and GARCIA, 1935.

*Heterophyes brevicaecai* AFRICA and GARCIA, 1935 of AFRICA, GARCIA, and DE LEON, 1935.

Intestine of man and bird (*Sterna albitrons sinensis*). Manila, Luzon.

References: 10, 19, 22, 23, 24, 26, 127, 193.

## Superfamily OPISTHORCHIOIDEA (Faust, 1929)

## Family OPISTHORCHIIDÆ Luehe, 1901

Subfamily OPISTHORCHIINÆ Looss, 1899

Genus OPISTHORCHIS R. Blanchard, 1895

**OPISTHORCHIS OPHIDIARUM Tubangui and Masiluñgan, 1935.**

Intestine of snake (*Lapemis hardwickii*). Paombong, Bulacan, Luzon.

Reference: 198.

**OPISTHORCHIS WARDI Wharton, 1921.**

*Opisthorchis felineus* (Rivolta, 1884) of authors.

*? Opisthorchis noverca* MUSGRAVE, 1907.

Bile ducts of cat. Manila and Los Baños, Laguna; Luzon.

References: 26, 49a, 66a, 112, 127, 174, 228.

Genus CLONORCHIS Looss, 1907

**CLONORCHIS SINENSIS (Cobbold, 1875) Looss, 1907.**

Presumably liver of man (Chinese). Manila and Los Baños, Laguna; Luzon.

References: 26, 48, 127, 148, 157.

Subfamily METORCHIINÆ Luehe, 1909

Genus METORCHIS Looss, 1899

**METORCHIS CAINTAENSIS Tubangui, 1928.**

Intestine of birds (*Rallus rallus philippensis* and *R. striatus striatus*). Cainta, Rizal, Luzon.

Reference: 177.

## Family ACANTHOSTOMATIDÆ Poche, 1925

Genus ACANTHOSTOMUM Looss, 1899

**ACANTHOSTOMUM ATAE Tubangui and Masilungan, 1936.**

Intestine of crocodile (*Crocodilus porosus*). Palawan.

Reference: 199.

**ACANTHOSTOMUM ELONGATUS Tubangui and Masilungan, 1936.**

Intestine of crocodile (*Crocodilus porosus*). Palawan.

Reference: 199.

## Superfamily TROGLOTREMATOIDEA (Faust, 1929)

## Family TROGLOTREMATIDÆ Odhner, 1914

Subfamily TROGLOTREMATINÆ Baer, 1931

Genus PARAGONIMUS Braun, 1899

**PARAGONIMUS WESTERMANI (Kerbert, 1878) Braun, 1899.**

Encysted in lungs and other organs of man and cat; also laboratory rat (experimental infection). First (snail) intermediate host not yet known; second intermediate host: freshwater crab [*Parathelphusa* (*Barythelphusa*) *mistio*]. Manila (?), Albay (Guinobatan), Camarines Sur (Naga) and Sorsogon (Gubat), Luzon; Samar; Leyte; Mindanao.

References: 39a, 49a, 65, 68, 77, 112, 127, 135, 172b, 174, 191, 191a, 215a.

## Superfamily HEMIUROIDEA (Faust, 1929)

## Family HEMIURIDÆ Luehe, 1901

Subfamily DINURINÆ Looss, 1907

Genus ECTENURUS Looss, 1907

**ECTENURUS LEMERIENSIS Tubangui and Masilungan, 1935.**

Small intestine of fishes (*Glossogobius giurus* and *Scomberoides* sp.). Manila and Balayan, Batangas; Luzon.

References: 198, 206.

## Family AZYGIIDÆ Odhner, 1911

### Genus AZYGIA Looss, 1899

**AZYGIA PRISTIPOMAI Tubangui, 1928.**

Intestine of fresh-water fishes (*Pomadasys hasta* and *Glossogobius giurus*). Manila and Los Baños, Laguna; Luzon.

References: 177, 206.

### SUPERFAMILIES UNCERTAIN

## Family STOMYLOTREMATIDÆ Poche, 1925

### Subfamily STOMYLOTREMATINÆ Travassos, 1922

### Genus STOMYLOTREMA Looss, 1900

**STOMYLOTREMA ROTUNDA Tubangui, 1928.**

Intestine of bird (*Rallus rallus philippensis*). Cainta, Rizal, Luzon.

Reference: 177.

## Family LECITHODENDRIIDÆ Odhner, 1911

### Subfamily LECITHODENDRIINÆ Looss, 1902

### Genus PROSTHODENDRIUM Dollfus, 1931

**PROSTHODENDRIUM LUZONICUM (Tubangui, 1928) Bhalerao, 1936.**

*Lecithodendrium luzonicum* TUBANGUI, 1928.

Small intestine of bat (*Scotophilus temminckii*). Los Baños, Laguna, Luzon.

References: 33, 177.

**PROSTHODENDRIUM OVIMAGNOSUM (Bhalerao, 1926) Bhalerao, 1936.**

*Lecithodendrium ovimagnosum* BHALERAO, 1926.

Small intestine of bat (*Scotophilus temminckii*). Los Baños, Laguna, Luzon.

References: 33, 177.

### Subfamily PLEUROGENETINÆ Looss, 1899

### Genus PLEUROGENOIDES Travassos, 1921

**PLEUROGENOIDES TAYLORI (Tubangui, 1928) Travassos, 1930.**

*Pleurogenes taylori* TUBANGUI, 1928.

Intestine of frog (*Rana vittigera*). Los Baños, Laguna, Luzon.

References: 94a, 171, 177.

### Genus POSTHORCHIGENES Tubangui, 1928

**POSTHORCHIGENES OVATUS Tubangui, 1928.**

Intestine of lizard (*Hemidactylus frenatus*). Los Baños, Laguna, Luzon.

Reference: 177.

## Family PSILOSTOMATIDÆ Odhner, 1913

### Subfamily PSILOSTOMATINÆ Looss, 1900

### Genus PSILOCHASMUS (Luehe, 1909) Odhner, 1913

**PSILOCHASMUS LONGICIRRATUS Skrjabin, 1913.**

Intestine of domesticated duck. Pateros, Rizal, Luzon.

Reference: 183.

## Family BRACHYLAEMIDÆ Joyeux and Foly, 1930

### Subfamily BRACHYLAEMINÆ Joyeux and Foly, 1930

### Genus BRACHYLAEMUS Dujardin, 1843

**BRACHYLAEMUS MALAYENSIS Tubangui and Masilungan, 1941.**

Cloaca of domestic chicken. Manila, Luzon.

Reference: 205.

**BRACHYLAEMUS sp. (Tubangui, 1928) comb. nov.**

*Harmostomum* sp. TUBANGUI, 1928.

Rectum of bird (*Dasylophus superciliosus*). Los Baños, Laguna, Luzon.

Reference: 177.

### Genus GLAPHYROSTOMUM Braun, 1901

**GLAPHYROSTOMUM RALLINARUM Tubangui, 1932.**

Intestine of bird (*Rallina eurizonoides eurizonoides*). Novaliches, Rizal, Luzon.

Reference: 183.

### Subfamily LEUCOCHLORIDIINÆ Poche, 1907

### Genus LEUCOCHLORIDIUM Carus, 1835

**LEUCOCHLORIDIUM DASYLOPHI Tubangui, 1928.**

Cloaca of bird (*Dasylophus superciliosus*). Los Baños, Laguna, Luzon.

Reference: 177.

**LEUCOCHLORIDIUM HYPOTAENIDIARUM** Tubangui, 1932.

Intestine of birds (*Rallus striatus striatus* and *Turnix fasciata*). Novaliches, Rizal, Luzon.

Reference: 183.

### Subfamily HARMOTREMATINÆ Yamaguti, 1933

#### Genus HARMOTREMA Nicoll, 1914

**HARMOTREMA EUGARI** Tubangui and Masiluñgan, 1936.

Intestine of snake (*Naja naja philippinensis*). Biñan, Laguna, Luzon.

Reference: 199.

**HARMOTREMA RUDOLPHII** Tubangui and Masiluñgan, 1936.

Intestine of crocodile (*Crocodilus porosus*). Palawan.

Reference: 199.

## Family PHILOPHTHALMIDÆ Travassos, 1921

### Subfamily PHILOPHTHALMINÆ Looss, 1899

#### Genus PHILOPHTHALMUS Looss, 1899

**PHILOPHTHALMUS PROBLEMATICUS** Tubangui, 1932.

Conjunctival sac of domestic chicken. Manila, Luzon.

Reference: 183.

**PHILOPHTHALMUS RIZALENSIS** Tubangui, 1932.

Conjunctival sac of domestic duck. Pateros, Rizal, Luzon.

Reference: 183.

## Family OPECOELIDÆ (Ozaki, 1925) Ozaki, 1928

#### Genus OPEGASTER Ozaki, 1923

**OPEGASTER MINIMUS** (Tubangui, 1928) Tubangui and Masiluñgan, 1944.

*Opecoelus minimus* TUBANGUI, 1928.

Intestine of fresh-water fishes (*Glossogobius giurus, Ophicephalus striatus, Therapon argenteus, Clarias batrachus* and *Arius manillensis*). Manila and Laguna de Bay, Laguna, Luzon.

References: 177, 206, 237.

### LARVAL TREMATODES (DIGENEA)

#### MONOSTOME CERCARIA

**CERCARIA PARVOMELANIAE** Tubangui, 1928.

Liver of snail (*Melania* sp.). Los Baños, Laguna, Luzon.

Reference: 176.

STRIGEID CERCARIA

**CERCARIA DORSOCAUDA Tubangui, 1928.**

Reproductive glands of snail (*Pila luzonica*). Los Baños, Laguna, Luzon.

Reference: 176.

DISTOME CERCARIAE

**CERCARIA LAGUNAENSIS Tubangui, 1928.**

Liver of snail (*Pila luzonica*). Los Baños, Laguna, Luzon.

Reference: 176.

**CERCARIA MAITIMENSIS Tubangui, 1928.**

Liver of snail (*Pila luzonica*). Los Baños, Laguna, Luzon.

References: 176, 199a.

**CERCARIA MAQUILINGI Tubangui, 1928.**

Liver of snails (*Melania* sp. and *M. asperata philippinensis*). Los Baños, Laguna, Luzon.

Reference: 176.

**CERCARIA MELANIASPERATA Tubangui, 1928.**

Liver of snails (*Melania asperata philippinensis* and *Melania* sp.). Los Baños, Laguna, Luzon.

Reference: 176.

**CERCARIA PHILIPPINDICA Tubangui, 1928.**

Liver of snail (*Melania* sp.). Los Baños, Laguna, Luzon.

Reference: 176.

**CERCARIA RARISSIMA Tubangui, 1928.**

Liver of snail (*Pila luzonica*). Los Baños, Laguna, Luzon.

Reference: 176.

**CERCARIA REDICYSTICA Tubangui, 1928.**

Reproductive glands of snail (*Pila luzonica*). Los Baños, Laguna, Luzon.

Reference: 176.

## Class CESTOIDEA (Rudolphi, 1808) Fuhrmann, 1931

## Subclass CESTODA Monticelli, 1892

### Order PSEUDOPHYLLIDEA Carus, 1863

### Superfamily BOTHRIOCEPHALOIDEA Braun, 1903

### Family BOTHRIOCEPHALIDÆ Braun, 1903

#### Genus BOTHRIOCEPHALUS Rudolphi, 1808

**BOTHRIOCEPHALUS TRAVASSOSI Tubangui, 1938.**

Intestine of fish (*Anguilla mauritiana*). Palo, Leyte.

Reference: 190.

## Family DIPHYLLOBOTHRIIDÆ Luehe, 1910

### Subfamily DIPHYLLOBOTHRIINÆ Luehe, 1899

#### Genus DIPHYLLOBOTHRIUM Cobbold, 1858

**DIPHYLLOBOTHRIUM LATUM (Linnæus, 1758) Luehe, 1910.**

*Dibothriocephalus latus* (LINNÆUS, 1758).

Presumably intestine of man. Biñan, Laguna, Luzon and San Jose, Mindoro.

References: 49a, 59, 61, 127, 218.

**DIPHYLLOBOTHRIUM MANSONI (Cobbold, 1883).**

*Bothriocephalus liguloides* LEUCKART, 1886.
*Dibothriocephalus* sp. of WHARTON, 1917.
*Diphyllobothrium* sp. of TUBANGUI, 1925.

Small intestine of cat and dog. First intermediate hosts: *Cyclops* (*Encyclops*) *serrulatus* and *C.* (*Microcyclops*) *bicolor;* second intermediate hosts: *Rana vittigera* and probably other species of frogs. Manila and Los Baños, Laguna, Luzon; Palo, Leyte.

References: 3, 49a, 127, 130, 141, 174, 190, 224.

#### Genus BOTHRIDIUM Blainville, 1824

**BOTHRIDIUM PITHONIS Blainville, 1824.**

Intestine of python (*Python reticulatus*). Manila and Los Baños, Laguna; Luzon.

References: 173, 190.

#### Genus DUTHIERSIA Perrier, 1873

**DUTHIERSIA FIMBRIATA (Diesing, 1850).**

Small intestine of lizard (*Varanus salvator*). Los Baños, Laguna and Alabang, Rizal; Luzon.

Reference: 190.

#### Genus SCYPHOCEPHALUS Riggenbach, 1898

**SCYPHOCEPHALUS SECUNDUS Tubangui, 1938.**

Intestine of lizard (*Varanus salvator*). Palo, Leyte.

Reference: 190.

#### LARVAL FORMS

**SPARGANUM Diesing, 1850 of Ira-Concepcion, 1935.**

Abdominal wall of man. Pulilan, Bulacan, Luzon.

Reference: 81.

**SPARGANUM PHILIPPINENSIS Tubangui, 1924.**

Peritoneum of palm civet (*Paradoxurus philippinensis*). Los Baños, Laguna, Luzon.

Reference: 173.

## Order CYCLOPHYLLIDEA Braun, 1900

## Superfamily TAENIOIDEA Zwicke, 1843

### Family TAENIIDÆ Ludwig, 1886

#### Subfamily TAENIINÆ Stiles, 1896

#### Genus TAENIA Linnæus, 1758

##### Subgenus TAENIA Linnæus, 1758

**TAENIA (TAENIA) HYDATIGENA Pallas, 1766.**

Small intestine of dog. Larval stage, *Cysticercus tenuicollis* Rudolphi, 1810, in mesentery of pig. Manila and Porac, Pampanga; Luzon.

References: 31, 141, 151, 174.

**TAENIA (TAENIA) PISIFORMIS (Bloch, 1780).**

Small intestine of dog. Manila, Luzon.

Reference: 31.

**TAENIA (TAENIA) SOLIUM Linnæus, 1758.**

*Taenia vulgaris* WERNER, 1782.

Small intestine of man. Larval stage *Cysticercus cellulosae* (Gmelin, 1790), in pig and man. Widely distributed.

References: 16, 41, 48, 49a, 59, 64, 83, 99, 127, 135, 141, 150, 151, 157, 163, 172b, 174.

##### Subgenus TAENIARHYNCHUS Weinland, 1858

**TAENIA (TAENIARHYNCHUS) SAGINATA Goeze, 1782.**

*Taenia (Taeniarhynchus) philippina* GARRISON, 1907.

Small intestine of man. Larval stage, *Cysticercus bovis,* in cattle. Widely distributed.

References: 41, 48, 49a, 59, 64, 88, 135, 136, 148, 150, 157, 162, 163, 172b, 174, 210a, 230.

##### Subgenus HYDATIGERA Lamarck, 1816

**TAENIA (HYDATIGERA) TAENIAFORMIS (Batsch, 1786).**

*Taenia crassicollis* RUDOLPHI, 1810.

Small intestine of cat. Larval stage, *Cysticercus fasciolaris* Rudolphi, 1808, in liver of rat (*Rattus norgevicus*). Widely distributed.

References: 141, 174, 182.

#### Genus ECHINOCOCCUS Rudolphi, 1801

**ECHINOCOCCUS GRANULOSUS (Batsch, 1786).**

*Taenia echinococcus* (ZEDER, 1803).

*Echinococcus polymorphus* DIESING, 1850.

Small intestine of dog. Larval stage in lungs and heart of man, cattle and carabao. Manila and Los Baños, Laguna; Luzon.

References: 49a, 64, 66a, 88, 92, 127, 141, 150, 163, 174.

## Family ANOPLOCEPHALIDÆ Cholodkovsky, 1902

### Subfamily ANOPLOCEPHALINÆ Fuhrmann, 1907

### Genus ANOPLOCEPHALA E. Blanchard, 1848

**ANOPLOCEPHALA MAMILLANA (Mehlis, 1831).**

Small intestine, colon and cæcum of horse. Los Baños, Laguna, Luzon.

References: 88a, 141, 156, 174.

**ANOPLOCEPHALA PERFOLIATA (Goeze, 1782).**

Small intestine, colon and cæcum of horse. Los Baños, Laguna, Luzon.

References: 88a, 141, 156, 174, 221.

### Genus MONIEZIA Blanchard, 1891

**MONIEZIA BENEDENI (Moniez, 1879).**

*Moniezia planissima* STILES and HASSALL, 1893.

Intestine of cattle and carabao. Boñgabong, Nueva Ecija, Luzon; Mindanao.

References: 88, 150, 194.

**MONIEZIA EXPANSA (Rudolphi, 1810).**

Intestine of cattle, sheep, and goat. Mindanao.

References: 49a, 88, 141, 150, 174.

**MONIEZA TRIGONOPHORA Stiles and Hassall, 1893.**

Intestine of sheep. Manila, Luzon.

References: 141, 150, 174.

### Genus BERTIELLA Stiles and Hassall, 1902

**BERTIELLA STUDERI (R. Blanchard, 1891).**

Intestine of man, dog and monkey (*Pithecus philippinensis*). Manila and Novaliches, Rizal, Luzon; Sara, Iloilo, Panay.

References: 9, 127.

### Genus APORINA Fuhrmann, 1903

**APORINA DELAFONDI (Railliet, 1892) Baer, 1927.**

Intestine of wild pigeon (*Streptopelia bitorquata dussumieri*). Villaviciosa, Abra, Luzon.

Reference: 202.

Subfamily LINSTOWIINÆ Fuhrmann, 1907

Genus Oochoristica Luehe, 1898

**OOCHORISTICA EXCELSA Tubangui and Masiluñgan, 1936.**

Intestine of lizard (*Mabuya multifasciata*). Los Baños, Laguna, Luzon.

Reference: 200.

Subfamily THYSANOSOMINÆ Fuhrmann, 1907

Genus AVITELLINA Gough, 1911

**AVITELLINA BUBALINAE Tubangui and Farinas, 1930.**

Small intestine of carabao. Boñgabong, Nueva Ecija, Luzon.

Reference: 194.

## Family DAVAINEIDÆ Fuhrmann, 1907

Subfamily DAVAINEINÆ Braun, 1900

Genus DAVAINEA (R. Blanchard, 1891)

**DAVAINEA PROGLOTTINA (Davaine, 1860).**

*Davainea varians* SWEET, 1910.
*Davainea dubius* MEGGITT, 1916.

Small intestine of domestic chicken. Los Baños, Laguna, Luzon.

Reference: 175.

Genus RAILLIETINA Fuhrmann, 1920

Subgenus RAILLIETINA Stiles and Orleman, 1926

**RAILLIETINA (RAILLIETINA) DAETENSIS Tubangui and Masiluñgan, 1937.**

Intestine of bird (*Treron* sp.). Daet, Camarines Norte, Luzon.

Reference: 202.

**RAILLIETINA (RAILLIETINA) GARRISONI Tubangui, 1931.**

Small intestine of rat (*Rattus norvegicus*) and man. Manila, Luzon.

References: 7, 129, 182.

**RAILLIETINA (RAILLIETINA) MADAGASCARIENSIS (Davaine, 1869).**

Small intestine of man. Manila, Luzon.

References: 7, 67, 129.

**RAILLIETINA (RAILLIETINA) SEQUENS Tubangui and Masiluñgan, 1937.**

Intestine of bird (*Streptopelia bitorquata dussumieri*). Makatipo, Rizal, Luzon.

Reference: 202.

**RAILLIETINA (RAILLIETINA) TETRAGONA (Molin, 1858).**

*Davainea tetragona* of authors.

Small intestine of domestic chicken. Widely distributed.
References: 154, 175.

**RAILLIETINA (RAILLIETINA) TORQUATA var. RAJAE Tubangui and Masiluñgan, 1937.**

Intestine of domestic pigeon. Manila, Luzon.
Reference: 202.

**Subgenus PARONIELLA Fuhrmann, 1920**

**RAILLIETINA (PARONIELLA) BULBULARUM Tubangui and Masiluñgan, 1937.**

Intestine of bird (*Pycnonotus goiavier goiavier*). Novaliches, Rizal, Luzon.
Reference: 202.

**RAILLIETINA (PARONIELLA) CIRROFLEXA Tubangui and Masiluñgan, 1937.**

Intestine of bird (*Lichtensteinipicus funebris*). Sipocot, Camarines Sur, Luzon.
Reference: 202.

**RAILLIETINA (PARONIELLA) CORONEA Tubangui and Masiluñgan, 1937.**

Intestine of bird (*Corvus coronoides*). Novaliches, Rizal, Luzon.
Reference: 202.

**RAILLIETINA (PARONIELLA) CULIAUANA Tubangui and Masiluñgan, 1937.**

Intestine of bird (*Oriolus chinensis chinensis*). Palo, Leyte.
Reference: 202.

**RAILLIETINA (PARONIELLA) TINGUIANA Tubangui and Masiluñgan, 1937.**

Intestine of wild chicken (*Gallus gallus gallus*). Villaviciosa, Abra, Luzon.
Reference: 202.

**Subgenus FUHRMANNETTA Stiles and Orleman, 1926**

**RAILLIETINA (FUHRMANNETTA) ECHINOBOTHRIDA (Megnin, 1880).**

*Davainea echinobothrida* of authors.

Small intestine and cæca of domestic chicken. Widely distributed.
Reference: 175.

**Genus COTUGNIA Diamare, 1893**

**COTUGNIA DIGONOPHORA (Pasquale, 1890).**

*Taenia digonophora* PASQUALE, 1890.

Small intestine of domestic chicken. Los Baños, Laguna, Luzon.
Reference: 175.

**COTUGNIA ILOCANA Tubangui and Masilungan, 1937.**

Intestine of bird (*Streptopelia bitorquata dussumieri*). Villaviciosa, Abra, Luzon.

Reference: 202.

**COTUGNIA RIMANDOI Tubangui and Masilungan, 1937.**

Intestine of domestic pigeon. Manila, Luzon.

Reference: 202.

**COTUGNIA sp. Tubangui, 1926.**

Small intestine of domestic chicken. Los Baños, Laguna, Luzon.

Reference: 175.

## Family DILEPIDIDÆ (Fuhrmann, 1907)

### Subfamily DILEPIDINÆ Furhmann, 1907

### Genus AMOEBOTAENIA Cohn, 1899

**AMOEBOTAENIA SPHENOIDES (Railliet, 1892).**

*Taenia cuneata* VON LINSTOW, 1872.
*Taenia sphenoides* RAILLIET, 1892.

Small intestine of domestic chicken. Widely distributed.

Reference: 175.

### Genus KOWALEWSKIELLA Baczyńska, 1914

**KOWALEWSKIELLA BUZZARDIA Tubangui and Masilungan, 1937.**

Intestine of bird (*Butastur indicus*). Palo, Leyte.

Reference: 202.

### Subfamily DIPYLIDIINÆ Stiles, 1896

### Genus DIPYLIDIUM Leuckart, 1863

**DIPYLIDIUM BUENCAMINOI Tubangui, 1925.**

Small intestine of dog. Manila, Luzon.

References: 96, 97, 174, 235.

**DIPYLIDIUM CANINUM (Linnæus, 1758).**

*Taenia canina* LINNÆUS, 1758.
*Taenia cucumerina* BLOCH, 1782.
*Dipylidium oerleyi* VON RATZ, 1900.
*Dipylidium sexcoronatum* VON RATZ, 1900.
*Dipylidium halli* TUBANGUI, 1925.

Small intestine of man, cat and dog. Widely distributed.

References: 49a, 96, 97, 107, 127, 130, 141, 154, 172b, 174, 224, 235.

## Family HYMENOLEPIDIDÆ Railliet and Henry, 1909

### Subfamily HYMENOLEPIDINÆ Ransom, 1909

#### Genus HYMENOLEPIS Weinland, 1858

**HYMENOLEPIS CARIOCA (Magalhaes, 1898).**

*Weinlandia carioca* (Magalhaes, 1898) MAYHEW, 1923.

Small intestine of domestic chicken. Widely distributed.
Reference: 175.

**HYMENOLEPIS CORONOIDIS Tubangui and Masilungan, 1937.**

Intestine of bird (*Corvus coronoides*). Palo, Leyte.
Reference: 202.

**HYMENOLEPIS DIMINUTA (RUDOLPHI, 1819).**

*Taenia diminuta* RUDOLPHI, 1819.
*Hymenolepis flavopunctata* WEINLAND, 1858.
*Taenia flavomaculata* LEUCKART, 1863.

Small intestine of man and rat (*Rattus norvegicus*). Manila, Luzon; Samar; probably widely distributed.
References: 59, 64, 141, 157, 172b, 182.

**HYMENOLEPIS NANA (von Siebold, 1852).**

*Taenia murina* DUJARDIN, 1845.
*Taenia aegyptiaca* BILHARZ, 1852.
*Hymenolepis fraterna* STILES, 1906.
*Hymenolepis longior* BAYLIS, 1922.

Small intestine of man and rat (*Rattus norvegicus*). Manila, Luzon; Zamboanga, Mindanao; probably widely distributed.
References: 58, 63, 64, 65, 76, 134, 135, 141, 148, 182, 232.

**HYMENOLEPIS PYCNONOTI Tubangui and Masilungan, 1937.**

Intestine of bird (*Pycnonotus goiavier goiavier*). Sipocot, Camarines Sur, Luzon.
Reference: 202.

**HYMENOLEPIS sp. Tubangui and Masilungan, 1937.**

Intestine of bird (*Iole philippinensis philippinensis*). Novaliches, Rizal, Luzon.
Reference: 202.

#### Genus FUHRMANNIELLA Tseng, 1933

**FUHRMANNIELLA CLERCI Tseng, 1933.**

Intestine of bird (*Rostratula benghalensis benghalensis*). Novaliches, Rizal, Luzon.
Reference: 202.

**Genus DIORCHIS Clerc, 1903**

**DIORCHIS VISAYANA Tubangui and Masilungan, 1937.**

Intestine of bird (*Gallinula chloropus lozanoi*). Palo, Leyte.

Reference: 202.

**Genus HAPLOPARAXIS Clerc, 1903**

**HAPLOPARAXIS SANJUANENSIS Tubangui and Masilungan, 1937.**

Intestine of bird (*Capella gallinago gallinago*). San Juan, Rizal, Luzon.

Reference: 202.

## Family ACOLEIDÆ Ransom, 1909

**Genus GYROCOELIA Fuhrmann, 1899**

**GYROCOELIA PARADOXA (von Linstow, 1906).**

Intestine of bird (*Ochthodromus mongolus mongolus*). Palo, Leyte.

Reference: 202.

# Phylum NEMATHELMINTHES Vogt (Quoted by Carus, 1863)

# Class NEMATODA Rudolphi, 1808, Emend. Diesing, 1861

# Subclass APHASMIDIA Chitwood and Chitwood, 1933

## Order ENOPLIDA Chitwood, 1933

## Suborder TRICHURATA Skrjabin, 1916

### Superfamily TRICHUROIDEA Railliet, 1916

### Family TRICHURIDÆ Railliet, 1915

#### Subfamily TRICHURINÆ Ransom, 1911

**Genus TRICHURIS Roederer, 1761**

**TRICHURIS OVIS (Abildgaard, 1795).**

Large intestine of cattle, sheep and goat. Widely distributed.

References: 38, 88, 150, 174, 221.

**TRICHURIS TRICHIURA (Linnæus, 1771).**

*Trichuris suis* (SCHRANK, 1788).
*Trichocephalus dispar* RUDOLPHI, 1802.
*Trichocephalus trichuris* of EASTMAN, 1910.

Large intestine of man and pig. Widely distributed.

References: 39, 41, 48, 49a, 52a, 59, 63, 65, 69, 70, 78, 99, 108, 113, 135, 136, 148, 151, 158, 162, 174, 210a, 211, 212a.

**TRICHURIS VULPIS (Froelich, 1789).**

*Trichuris depressiuscula* (RUDOLPHI, 1809).

Cæcum of dog. Manila, Luzon.
References: 147, 174.

Subfamily CAPILLARIINÆ Railliet, 1915

Genus CAPILLARIA Zeder, 1800

**CAPILLARIA ANNULATA (Molin, 1858).**

*Thominx annulata* (MOLIN, 1858).
*Capillaria strumosa* (REIBISCH, 1893).

Under epithelium of crop of domestic chicken. Los Baños, Laguna, Luzon.
References: 175, 227.

**CAPILLARIA HEPATICA (Bancroft, 1893).**

*Hepaticola hepatica* (BANCROFT, 1893).

Liver of rat (*Rattus norvegicus*). Manila, Luzon.
References: 31b, 182.

**CAPILLARIA RETUSA (Railliet, 1893).**

*Trichosomum retusum* RAILLIET, 1893.

Cæca of domestic chicken. Los Baños, Laguna, Luzon.
Reference: 175.

Family TRICHOSOMOIDIDÆ Yorke and Maplestone, 1926

Subfamily TRICHOSOMOIDINÆ Hall, 1916

Genus TRICHOSOMOIDES Railliet, 1895

**TRICHOSOMOIDES CRASSICAUDA (Bellingham, 1840).**

*Trichosoma crassicauda* BELLINGHAM, 1840.
*Trichosoma muris-decumani* RAYER, 1843.

Urinary tract of rat (*Rattus norvegicus*). Manila, Luzon.
Reference: 182.

## Subclass PHASMIDIA Chitwood and Chitwood, 1933

### Order RHABDITIDA Chitwood, 1933

### Suborder RHABDITATA Chitwood, 1933

### Superfamily RHABDITOIDEA Travassos, 1920

Family STRONGYLOIDIDÆ Chitwood and McIntosh, 1934

Genus STRONGYLOIDES Grassi, 1879

**STRONGYLOIDES RATTI Sandground, 1925.**

*Strongyloides papillosus* (Wedl, 1856) HALL, 1916.

Small intestine of rat (*Rattus norvegicus*). Manila, Luzon.
Reference: 182.

**STRONGYLOIDES STERCORALIS (Bavay, 1876).**

*Strongyloides intestinalis* (BAVAY, 1877).

Small intestine of man. Manila, Cavite, Rizal and other provinces in Luzon; San Jose, Mindoro.

References: 39, 41, 49a, 51, 52a, 63, 65, 69, 70, 117a, 135, 136, 148, 162, 163, 218, 229, 230, 231, 232.

**STRONGYLOIDES SUIS (Lutz, 1885) von Linstow, 1905.**

Presumably small intestine of pig. Manila, Luzon.

References: 49a, 99.

## Suborder STRONGYLATA Railliet and Henry, 1913

### Superfamily STRONGYLOIDEA (Weinland, 1858)

### Family STRONGYLIDÆ Baird, 1853

#### Subfamily STRONGYLINÆ Railliet, 1893

#### Genus STRONGYLUS Mueller, 1780

##### Subgenus STRONGYLUS (Mueller, 1780) Railliet, 1923

**STRONGYLUS (STRONGYLUS) EQUINUS Mueller, 1780.**

*Strongylus armatus* RUDOLPHI, 1802.
*Sclerostoma equinum* BLAINVILLE, 1828.
*Strongylus neglectus* ROEPPEL, 1897.
*Sclerostomum quadridentatum* STICKER, 1901.

Large intestine of horse. Widely distributed.

References: 49a, 88a, 156, 174.

##### Subgenus ALFORTIA Railliet, 1923

**STRONGYLUS (ALFORTIA) EDENTATUS (Looss, 1900).**

*Sclerostoma edentatum* LOOSS, 1900.
*Strongylus edentatus* RAILLIET and HENRY, 1909.

Large intestine of horse. Widely distributed.

References: 49a, 88a, 156, 174.

##### Subgenus DELAFONDIA Railliet, 1923

**STRONGYLUS (DELAFONDIA) VULGARIS (Looss, 1900).**

*Sclerostoma vulgare* LOOSS, 1900.
*Sclerostoma bidentatum* STICKER, 1901.

Large intestine of horse. Widely distributed.

References: 49a, 88a, 156, 174, 221.

#### Genus OESOPHAGODONTUS Railliet and Henry, 1902

**OESOPHAGODONTUS ROBUSTUS (Giles, 1892)**

Large intestine of horse. Los Baños, Laguna, Luzon.

References: 88a, 174.

### Genus TRIODONTOPHORUS Looss, 1902

**TRIODONTOPHORUS MINOR (Looss, 1900).**

Large intestine of horse. Los Baños, Laguna, Luzon.
References: 88a, 156, 221.

**TRIODONTOPHORUS SERRATUS (Looss, 1900).**

*Triodontophorus intermedius* SWEET, 1909.

Large intestine of horse. Los Baños, Laguna, Luzon.
References: 88a, 156, 174, 221.

### Genus GLOBOCEPHALUS Molin, 1861

**GLOBOCEPHALUS LONGEMUCRONATUS Molin, 1861.**

Small intestine of pig. Los Baños, Laguna, Luzon.
References: 174, 221.

**GLOBOCEPHALUS SAMOENSIS (Lane, 1922).**

*Raillietstrongylus samoensis* (LANE, 1922).

Small intestine of pig. Los Baños, Laguna, Luzon.
Reference: 221.

**GLOBOCEPHALUS UROSUBULATUS (Alessandrini, 1909).**

Small intestine of pig. Los Baños, Laguna, Luzon.
Reference: 221.

### Subfamily TRICHONEMINÆ Railliet, 1916

### Genus TRICHONEMA Cobbold, 1874

**TRICHONEMA AURICULATUM (Looss, 1900).**

*Cylicostomum auriculatum* (Looss, 1900).

Large intestine of horse. Los Baños, Laguna, Luzon.
Reference: 174.

**TRICHONEMA BICORONATUM (Looss, 1900).**

*Cylicostomum bicoronatum* (Looss, 1900).

Large intestine of horse. Los Baños, Laguna, Luzon.
References: 156, 174, 221.

**TRICHONEMA CALICATUM (Looss, 1900).**

*Cylicostomum calicatum* (Looss, 1900).

Large intestine of horse. Los Baños, Laguna, Luzon.
References: 156, 221.

**TRICHONEMA CATINATUM (Looss, 1900).**

*Cylicostomum catinatum* (Looss, 1900).

Large intestine of horse. Los Baños, Laguna, Luzon.
References: 174, 221.

**TRICHONEMA CATINATUM var. PSEUDOCATINATA (Yorke and Macfie, 1919).**

*Cylicostomum pseudocatinatum* YORKE and MACFIE, 1919.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 174, 221.

**TRICHONEMA CORONATUM (Looss, 1900).**

*Cylicostomum coronatum* (LOOSS, 1900).

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 221.

**TRICHONEMA ELONGATUM (Looss, 1900).**

*Cylicostomum elongatum* (LOOSS, 1900).

Large intestine of horse. Los Baños, Laguna, Luzon. References: 174, 221.

**TRICHONEMA EUPROCTUM (Boulenger, 1917).**

*Cylicostomum euproctus* BOULENGER, 1917.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 221.

**TRICHONEMA GOLDI (Boulenger, 1917).**

*Cylicostomum goldi* BOULENGER, 1917.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 174, 221.

**TRICHONEMA GOLDI var. TRIDENTATA (Yorke and Macfie, 1920).**

*Cylicostomum tridentatum* YORKE and MACFIE, 1920.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 221.

**TRICHONEMA INSIGNE (Boulenger, 1917).**

*Cylicostomum insigne* BOULENGER, 1917.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 174, 221.

**TRICHONEMA LABIATUM (Looss, 1901).**

*Cylicostomum labiatum* (LOOSS, 1901).

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 174.

**TRICHONEMA LEPTOSTOMUM (Kotlan, 1920).**

*Cylicostomum leptostomum* KOTLAN, 1920.

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 156.

**TRICHONEMA LONGIBURSATUM (Yorke and Macfie, 1920).**

*Cylicostomum longibursatum* YORKE and MACFIE, 1920.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 174, 221.

**TRICHONEMA MINUTUM (Yorke and Macfie, 1918).**

*Cylicostomum minutum* YORKE and MACFIE, 1918.

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 174.

**TRICHONEMA NASSUTUM (Looss, 1900).**

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 221.

**TRICHONEMA NASSUTUM var. PARVA (Yorke and Macfie, 1918).**

*Cylicostomum nassutum* var. *parvum* YORKE and MACFIE, 1918.

Large intestine of horse. Los Baños, Laguna, Luzon. References: 156, 174, 221.

**TRICHONEMA PATERATUM (Yorke and Macfie, 1919).**

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 221.

**TRICHONEMA RADIATUM (Looss, 1900).**

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 221.

**TRICHONEMA ULTRAJECTINUM (Ihle, 1920).**

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 221.

### Genus POTERIOSTOMUM Quiel, 1919

**POTERIOSTOMUM IMPARIDENTATUM Quiel, 1919.**

Large intestine of horse. Los Baños, Laguna, Luzon. References: 88a, 156, 174, 221.

**POTERIOSTOMUM RATZII (Kotlan, 1919).**

Large intestine of horse. Los Baños, Laguna, Luzon. Reference: 221.

### Genus GYALOCEPHALUS Looss, 1900

**GYALOCEPHALUS CAPITATUS Looss, 1900.**

Large intestine of horse. Los Baños, Laguna, Luzon. References: 88a, 156, 174, 221.

### Subfamily OESOPHAGOSTOMINÆ Railliet, 1915

### Genus OESOPHAGOSTOMUM Molin, 1861

**OESOPHAGOSTOMUM BIFURCUM (Creplin, 1849) Travassos and Vogelsang, 1932.**

*Oesophagostomum aculeatum* (VON LINSTOW, 1879).
*Oesophagostomum apiostomum* (WILLACH, 1891).

Large intestine of monkey (*Pithecus philippinensis*). Different places in the Philippines.

References: 93a, 172a, 216.

**OESOPHAGOSTOMUM COLUMBIANUM (Curtice, 1890).**

*Proteracrum columbianum* (CURTICE, 1890).

Large intestine of sheep and goat; also cattle. Manila and other places in Luzon; probably widely distributed.

References: 38, 49a, 88, 150, 174, 221.

**OESOPHAGOSTOMUM DENTATUM (Rudolphi, 1803).**

Large intestine of pig. Widely distributed.

References: 99, 151, 174, 221.

**OESOPHAGOSTOMUM LONGICAUDUM Goodey, 1925.**

Presumably large intestine of pig. Exact locality not specified.

Reference: 153.

**OESOPHAGOSTOMUM RADIATUM (Rudolphi, 1803).**

*Strongylus radiatus* RUDOLPHI, 1803.
*Strongylus inflatus* SCHNEIDER, 1866.
*Strongylus dilatatus* RAILLIET, 1884.
*Oesophagostomum inflatum* (SCHNEIDER, 1866).
*Oesophagostomum dilatatum* (RAILLIET, 1884).
*Oesophagostomum bovis* SCHNYDER, 1906.
*Proteracrum radiatum* RAILLIET and HENRY, 1913.

Ileum and large intestine of cattle and goat. Widely distributed.

References: 49a, 53, 88, 174.

**OESOPHAGOSTOMUM VENULOSUM (Rudolphi, 1809).**

Large intestine of goat. Widely distributed.

References: 49a, 174, 221.

**OESOPHAGOSTOMUM sp. Boynton and Wharton, 1916.**

*Proteracrum* sp. (BOYNTON and WHARTON, 1916).

Cæcum of cow. Minalabag, Camarines Sur, Luzon.

References: 38, 150.

Subfamily STEPHANURINÆ Railliet, Henry and Bauche, 1919

Genus STEPHANURUS Diesing, 1839

**STEPHANURUS DENTATUS Diesing, 1839.**

Perirenal fat, kidney, liver and other organs of pig. Widely distributed.

References: 34, 35, 49a, 72, 84, 86, 99, 115, 151, 174.

Family ANCYLOSTOMATIDÆ (Looss, 1905) Lane, 1917

Subfamily ANCYLOSTOMATINÆ (Looss, 1905) Stephens, 1916

Genus ANCYLOSTOMA (Dubini, 1843) Creplin, 1845

**ANCYLOSTOMA BRAZILIENSE de Faria, 1910.**

*Ancylostoma ceylanicum* Looss, 1911.

Small intestine of cat, dog and man. Widely distributed.

References: 2, 49, 49a, 100, 101, 103, 127, 146, 174, 195.

**ANCYLOSTOMA CANINUM (Ercolani, 1859).**

Small intestine of dog and cat; also man. Widely distributed.

References: 49a, 101, 127, 164, 174, 195, 224.

**ANCYLOSTOMA DUODENALE (Dubini, 1843).**

*Ankylostomum duodenale* (Dubini, 1843).
*Agchylostoma duodenale* Dubini, 1843.
*Dochmius duodenalis* (Dubini, 1843).

Small intestine of man. Widely distributed.

References: 52a, 59, 65, 90, 91, 101, 103, 127, 135, 148, 158, 162a, 172b, 195, 212a.

Subfamily NECATORINÆ Lane, 1917

Genus NECATOR Stiles, 1903

**NECATOR AMERICANUS (Stiles, 1902).**

*Uncinaria americana* Stiles, 1902.
*Necator americanus* var. *suillus* of Mallari, 1940.

Small intestine of man and pig. Widely distributed.

References: 40, 41, 47, 59, 65, 70, 90, 91, 99, 101, 103, 127, 135, 148, 158, 162a, 172b, 195, 212.

Genus UNCINARIA Froelich, 1789

**UNCINARIA PHILIPPINENSIS Chitwood, 1932.**

Small intestine of civet (*Paradoxurus philippinensis*). The locality given is Washington, D. C., but it is probable that the host animal picked up the parasite in the Philippines.

Reference: 44.

### Genus BUNOSTOMUM Railliet, 1902

**BUNOSTOMUM PHLEBOTOMUM (Railliet, 1900).**

*Monodontus phlebotomus* (RAILLIET, 1900).

Small intestine of sheep, goat and cattle. Widely distributed.
References: 38, 88, 150, 174, 221.

**BUNOSTOMUM TRIGONOCEPHALUM (Rudolphi, 1808).**

*Monodontus trigonocephalus* (RUDOLPHI, 1808).

Small intestine of sheep, goat and cattle. Widely distributed.
References: 88, 102, 174, 221.

## Family DIAPHANOCEPHALIDÆ Travassos, 1919

### Genus KALICEPHALUS Molin, 1861

**KALICEPHALUS sp. Tubangui and Masiluñgan, 1937.**

Intestine of snake (*Naja naja philippinensis*). Alabang, Rizal, Luzon.
Reference: 203.

## Family SYNGAMIDÆ Leiper, 1912

### Genus SYNGAMUS Siebold, 1836

**SYNGAMUS LARYNGEUS Railliet, 1899.**

*Cyathostoma* of ST. JOHN, SIMMONS, and GARDNER, 1929.

Upper respiratory tract (larynx) of cattle and carabao; also man. Widely distributed; human case from Lanao, Mindanao.
References: 36, 49a, 75, 88, 150, 165, 174.

## Superfamily TRICHOSTRONGYLOIDEA Cram, 1927

## Family TRICHOSTRONGYLIDÆ Leiper, 1912

### Subfamily TRICHOSTRONGYLINÆ Leiper, 1908

### Genus HYOSTRONGYLUS Hall, 1921

**HYOSTRONGYLUS RUBIDUS (Hassall and Stiles, 1892).**

Stomach of pig. Los Baños, Laguna, Luzon.
Reference: 151.

### Genus HAEMONCHUS Cobb, 1898

**HAEMONCHUS CONTORTUS (Rudolphi, 1803).**

Abomasum of cattle, sheep and goat. Widely distributed.
References: 38, 49a, 88, 150, 174.

### Genus MOLINEUS Cameron, 1923

**MOLINEUS ASIATICUS Tubangui and Masiluñgan, 1937.**

Small intestine of civet (*Paradoxurus philippinensis*). Balanga, Bataan, Luzon.
Reference: 203.

**Genus SCHWARTZIELLA Leroux, 1936**

**SCHWARTZIELLA NODULOSA (Schwartz, 1928) Leroux, 1936.**

*Cooperia nodulosa* SCHWARTZ, 1928.

In nodules in mucosa of small intestine of carabao. Los Baños, Laguna, Luzon.

References: 71, 93, 155.

**Genus MECISTOCIRRUS (Railliet and Henry, 1912)**

**MECISTOCIRRUS DIGITATUS (von Linstow, 1906).**

Small intestine of cattle. Los Baños, Laguna, Luzon.

Reference: 221.

**Subfamily HELIGMOSOMINÆ Travassos, 1914**

**Genus NIPPOSTRONGYLUS Lane, 1923**

**NIPPOSTRONGYLUS MURIS (Yokogawa, 1920).**

*Heligmosomum muris* YOKOGAWA, 1920.

Small intestine of rat (*Rattus norvegicus*). Manila, Luzon.

Reference: 182.

## Superfamily METASTRONGYLOIDEA Cram, 1927

## Family METASTRONGYLIDÆ Leiper, 1908

**Subfamily METASTRONGYLINÆ Leiper, 1908**

**Genus METASTRONGYLUS Molin, 1861**

**METASTRONGYLUS ELONGATUS (Dujardin, 1845).**

Bronchi and bronchioles of pig. Los Baños, Laguna, Luzon.

References: 49a, 151, 172b, 174.

**METASTRONGYLUS SALMI Gedoelst, 1923.**

Bronchi and bronchioles of pig. Manila and Los Baños, Laguna; Luzon.

References: 149, 221.

**Genus DICTYOCAULUS Railliet and Henry, 1907**

**DICTYOCAULUS VIVIPARUS (Bloch, 1782).**

Bronchi of cattle. Manila and Los Baños, Laguna; Luzon.

References: 49a, 88, 221.

## Suborder OXYURATA Cram, 1927

## Superfamily OXYUROIDEA Railliet, 1916

## Family OXYURIDÆ Cobbold, 1864

**Subfamily OXYURINÆ Hall, 1916**

**Genus OXYURIS Rudolphi, 1803**

**OXYURIS EQUI (Schrank, 1789).**

Large intestine of horse. Widely distributed.

References: 88a, 145, 156, 174, 221.

### Genus ENTEROBIUS Leach, 1853

**ENTEROBIUS VERMICULARIS (Linnæus, 1758).**

*Oxyuris vermicularis* (LINNÆUS, 1758).

Cæcum, vermiform appendix and adjacent levels of colon and small intestine of man. Widely distributed.

References: 6a, 39, 41, 41b, 42, 48, 63, 65, 69, 70, 78, 108, 135, 136, 148, 163, 210a, 229, 230, 231, 232.

### Genus AUCHENACANTHA Baylis, 1929

(= HOEPPLIUS Chu, 1931)

**AUCHENACANTHA BOHOLI (Chu, 1931) Robinson, 1934.**

*Hoepplius boholi* CHU, 1931.

Large intestine and cæcum of flying lemur (*Cyanocephalus volans*). Bilar, Bohol.

References: 46, 136a.

**AUCHENACANTHA COROLLATA (Schneider, 1866) Robinson, 1934.**

*Oxyuris corollatus* SCHNEIDER, 1866.

Intestine of flying lemur (*Cyanocephalus volans*). Luzon.

References: 136a, 140.

**AUCHENACANTHA HOEPPLII (Chu, 1931) Robinson, 1934.**

*Hoepplius spinosus* CHU, 1931.

Large intestine and cæcum of flying lemur (*Cyanocephalus volans*). Bilar, Bohol.

References: 46, 136a.

### Subfamily SYPHACIINÆ Railliet, 1916

### Genus SYPHACIA Seurat, 1916

**SYPHACIA OBVELATA (Rudolphi, 1802).**

Large intestine of rat (*Rattus norvegicus*) and man. Zamboanga, Mindanao.

References: 134, 182.

### Subfamily OXYSOMATIINÆ Railliet, 1916

### Genus OXYSOMATIUM Railliet and Henry, 1913

**OXYSOMATIUM RANAE Walton, 1931.**

Intestine of frog (*Rana magna*). Exact locality not specified.

Reference: 219.

### Genus PROBSTMAYRIA Ransom, 1907

**PROBSTMAYRIA VIVIPARA (Probstmayr, 1865).**

Large intestine of horse. Los Baños, Laguna, Luzon.

References: 88a, 156, 174.

## Family THELASTOMATIDÆ Travassos, 1929

### Subfamily THELASTOMATINÆ Travassos, 1920

#### Genus THELASTOMA (Leidy, 1849)

**THELASTOMA PALMETTUM Chitwood and Chitwood, 1933.**

Presumably intestine of cockroach (*Panesthia javanica*). Exact locality not specified.

Reference: 45.

#### Genus BLATTOPHILA Cobb, 1920

**BLATTOPHILA SPHAEROLAIMA var. JAVANICA Chitwood and Chitwood, 1933.**

Presumably intestine of cockroach (*Panesthia javanica*). Exact locality not specified.

Reference: 45.

#### Genus AORURUS Leidy, 1849

**AORURUS PHILIPPINENSIS Chitwood and Chitwood, 1933.**

Presumably intestine of cockroach (*Panesthia javanica*). Exact locality not specified.

Reference: 45.

#### Genus LEIDYNEMA Schwenk in Travassos, 1929

**LEIDYNEMA NOCALUM Chitwood and Chitwood, 1933.**

Presumably intestine of cockroach (*Panesthia javanica*). Exact locality not specified.

Reference: 45.

#### Genus LEIDYNEMELLA Chitwood and Chitwood, 1933

**LEIDYNEMELLA PARACRANIFERA Chitwood and Chitwood, 1933.**

Presumably intestine of cockroach (*Panesthia javanica*). Exact locality not specified.

Reference: 45.

## Suborder ASCARIDATA Railliet and Henry, 1915

### Superfamily ASCAROIDEA Railliet and Henry, 1915

## Family ASCARIDÆ Baird, 1853

### Subfamily ASCARINÆ (Railliet and Henry, 1912)

#### Genus ASCARIS Linnæus, 1758

**ASCARIS LUMBRICOIDES Linnæus, 1758.**

*Ascaris suum* GOEZE, 1782.

*Ascaris suilla* DUJARDIN, 1845.

Small intestine of man and pig. Widely distributed.

References: 12, 13, 39, 41, 41a, 48, 49a, 52a, 59, 63, 65, 69, 70, 78, 99, 108, 111, 135, 136, 151, 158, 162, 163, 166, 172b, 174, 210a, 211, 211a, 212a, 222, 223, 229, 230, 231, 232.

### Genus NEOASCARIS Travassos, 1927

**NEOASCARIS VITULORUM (Goeze, 1782).**

*Ascaris vitulorum* GOEZE, 1782.

Small intestine of cattle and carabao. Widely distributed.
References: 49a, 88, 142, 143, 144, 150, 174.

### Genus PARASCARIS Yorke and Maplestone, 1926

**PARASCARIS EQUORUM (Goeze, 1782).**

*Ascaris equorum* GOEZE, 1782.

Small intestine of horse. Widely distributed.
References: 49a, 88a, 156, 174, 221.

### Genus TOXOCARA Stiles, 1905

**TOXOCARA CANIS (Werner, 1782).**

*Belascaris marginata* (RUDOLPHI, 1802).
*Toxascaris canis* (WERNER, 1782) of authors.
*Toxacaris canis* of ST. JOHN and SIMMONS, 1931.

Small intestine of dog. Widely distributed.
References: 49a, 127, 130, 142, 164, 174, 224.

**TOXOCARA CATI (Schrank, 1788) Brumpt, 1927.**

*Belascaris* cati (SCHRANK, 1788).
*Belascaris mystax* (ZEDER, 1800).
*Toxocara mystax* (ZEDER, 1800).

Small intestine of cat. Widely distributed.
References: 127, 142, 174.

### Genus TOXASCARIS Leiper, 1907

**TOXASCARIS LEONINA (von Linstow, 1902).**

*Toxascaris limbata* RAILLIET and HENRY, 1911.

Small intestine of dog. Manila, Luzon.
Reference: 224.

### Subfamily ASCARIDIINÆ Travassos, 1919

### Genus ASCARIDIA Dujardin, 1845

**ASCARIDIA COMPAR (Schrank, 1790).**

*Heterakis compar* (SCHRANK, 1790).

Small intestine and "stomach" of domestic chicken. Exact locality not specified.
References: 114, 175.

**ASCARIDIA GALLI (Schrank, 1788).**

*Ascaridia perspicillum* (RUDOLPHI, 1803).
*Heterakis lineata* (SCHNEIDER, 1866).
*Ascaridia lineata* (SCHNEIDER, 1866).

Small intestine of domestic chicken. Widely distributed.
References: 49a, 142, 175.

**ASCARIDIA SUBEQUALIS Wehr, 1930.**

Intestine of Cuckoo sp. Exact locality not specified.
Reference: 220.

## Family HETERAKIDÆ Railliet and Henry, 1914

### Subfamily HETERAKINÆ Railliet and Henry, 1912

#### Genus HETERAKIS Dujardin, 1845

**HETERAKIS BERAMPORIA Lane, 1914.**

Cæca of domestic chicken. Widely distributed.
References: 152, 175.

**HETERAKIS GALLINAE (Gmelin, 1790).**

*Heterakis papillosa* (BLOCH, 1782).
*Heterakis vesicularis* (FROELICH, 1791).

Cæca of domestic chicken. Widely distributed.
References: 142, 175.

**HETERAKIS SPUMOSA Schneider, 1866.**

*Ganguleterakis gangula* LANE, 1914.

Large intestine of rat (*Rattus norvegicus*). Manila, Luzon.
Reference: 182.

## Family SUBULURIDÆ Yorke and Maplestone, 1926

### Subfamily SUBULURINÆ Travassos, 1914

#### Genus SUBULURA Molin, 1860

**SUBULURA CYNOMOLGI Tubangui and Villaamil, 1933.**

Large intestine of monkey (*Pithecus philippinensis*). Novaliches, Rizal and Los Baños, Laguna; Luzon.
Reference: 210.

## Family KATHLANIDÆ (Travassos, 1918)

### Subfamily KATHLANINÆ Lane, 1914

#### Genus SPIRONOURA Leidy, 1856

**SPIRONOURA DUYAGI Tubangui and Villaamil, 1933.**

Cæcum of turtle (*Cyclemis amboinensis*). Novaliches, Rizal, Luzon.
Reference: 210.

Subfamily CISSOPHYLLINÆ Yorke and Maplestone, 1926

Genus CISSOPHYLLUS Railliet and Henry, 1912

**CISSOPHYLLUS LEYTENSIS Tubangui and Villaamil, 1933.**

Large intestine of lizard (*Hydrosaurus pustulosus*). Palo, Leyte and Novaliches, Rizal, Luzon.

Reference: 210.

## Order SPIRURIDA Chitwood, 1933

## Suborder SPIRURATA Railliet and Henry, 1915

### Superfamily SPIRUROIDEA Railliet and Henry, 1915

### Family SPIRURIDÆ Oerley, 1885

Subfamily SPIRURINÆ Railliet, 1915

Genus SPIROCERCA Railliet and Henry, 1911

**SPIROCERCA LUPI (Rudolphi, 1809).**

*Spiroptera sanguinolenta* (RUDOLPHI, 1819).
*Spirocerca sanguinolenta* (RUDOLPHI, 1819).

In nodules in walls of œsophagus, stomach, trachea and aorta of dog. Manila and Los Baños, Laguna; Luzon.

References: 174, 221, 224.

Genus HABRONEMA Diesing, 1861

**HABRONEMA MEGASTOMA (Rudolphi, 1819).**

Stomach of horse. Manila and Los Baños, Laguna; Luzon.

References: 88a, 156, 168, 174, 221.

**HABRONEMA MICROSTOMA (Schneider, 1866).**

Stomach of horse. Manila and Los Baños, Laguna; Luzon.

References: 88a, 156, 174, 221.

**HABRONEMA MUSCAE (Carter, 1861).**

Stomach of horse. Manila and Los Baños, Laguna; Luzon.

References: 88a, 156, 174, 221.

Genus METABRONEMA Yorke and Maplestone, 1926

**METABRONEMA CARANXI Tubangui and Masilungan, 1937.**

Abdominal cavity of fish (*Caranx speciosus*). San Narciso, Tayabas, Luzon.

Reference: 203.

Subfamily ASCAROPSINÆ Alicata and McIntosh, 1933

Genus ASCAROPS van Beneden, 1873

**ASCAROPS STRONGYLINA (Rudolphi, 1819) Alicata and McIntosh, 1933.**

*Arduenna strongylina* (RUDOLPHI, 1819).

Stomach of pig. Los Baños, Laguna, Luzon.

References: 28a, 151, 174, 221.

Genus PHYSOCEPHALUS Diesing, 1861

**PHYSOCEPHALUS SEXALATUS (Molin, 1860).**

Stomach of pig. Los Baños, Laguna, Luzon.

Reference: 174.

Subfamily GONGYLONEMATINÆ Hall, 1916

Genus GONGYLONEMA Molin, 1857

**GONGYLONEMA INGLUVICOLA Ransom, 1904.**

Under mucous lining of crop of domestic chicken. Los Baños, Laguna, Luzon.

References: 175, 227.

**GONGYLONEMA NEOPLASTICUM (Fibiger and Ditlevsen, 1914).**

*Spiroptera neoplastica* FIBIGER and DITLEVSEN, 1914.

Under mucous lining of stomach of rat (*Rattus norvegicus*). Manila, Luzon.

Reference: 182.

**GONGYLONEMA sp. Tubangui and Masilungan, 1937.**

Under mucous lining of stomach of rodent (*Crateromys schadenbergi*). Nueva Vizcaya, Luzon.

Reference: 203.

Family GNATHOSTOMATIDÆ Blanchard, 1895

Subfamily GNATHOSTOMATINÆ Baylis and Lane, 1920

Genus GNATHOSTOMA Owen, 1836

**GNATHOSTOMA DOLORESI Tubangui, 1925.**

Stomach of pig. Los Baños, Laguna, Luzon.

References: 106, 174.

**GNATHOSTOMA HISPIDUM Fedtschenko, 1872.**

Stomach of pig. Los Baños, Laguna, Luzon.

References: 49a, 151.

**GNATHOSTOMA SPINIGERUM Owen, 1836.**

*Filaria radula* SCHNEIDER, 1866.

Stomach of dog, cat, and civet (*Paradoxurus philippinensis*). First intermediate hosts: *Cyclops* (*Encyclops*) *serrulatus* and

*C.* (*Microcyclops*) *bicolor;* second intermediate hosts: fishes (*Glossogobius giurus, Ophicephalus striatus* and *Therapon argenteus*). Probably widely distributed.

References: 27, 28, 32, 49a, 127, 133, 140, 174.

Subfamily SPIROXYINÆ Baylis and Lane, 1920

Genus **PROTOSPIRURA** Seurat, 1914

**PROTOSPIRURA MURICOLA Gedoelst, 1916.**

*Ascaris* of SCHOBL, 1913.

Stomach of rat (*Rattus norvegicus*). Manila, Luzon.

References: 140a, 182.

## Family PHYSALOPTERIDÆ Leiper, 1908

Subfamily PHYSALOPTERINÆ Railliet, 1893

Genus **PHYSALOPTERA** Rudolphi, 1819

**PHYSALOPTERA AMPHIBIA von Linstow, 1899.**

"Ventricle" and œsophagus of frog (*Rana magna*). Luzon.

Reference: 95.

**PHYSALOPTERA PACITAE Tubangui, 1925.**

Stomach of cat. Los Baños, Laguna, Luzon.

Reference: 174.

Genus **CHLAMYDONEMA** Hegt, 1910

**CHLAMYDONEMA PRAEPUTIALE (von Linstow, 1889).**

*Physaloptera praeputiale* VON LINSTOW, 1889.

Stomach of dog. Manila, Luzon.

Reference: 154.

## Family THELAZIIDÆ Railliet, 1916

Genus **THELAZIA** Bosc, 1819

**THELAZIA PHILIPPINENSIS Wehr, 1930.**

Eye of bird (*Thriponax* sp.). Exact locality not specified.

Reference: 220.

**THELAZIA RHODESI (Desmarest, 1827).**

Eye of cattle. Widely distributed.

References: 88, 150.

Genus **OXYSPIRURA** Drasche in Stossich, 1897

**OXYSPIRURA MANSONI (Cobbold, 1879).**

*Filaria mansoni* COBBOLD, 1879.

Eye of domestic chicken. Widely distributed.

References: 54, 175.

### Genus CERATOSPIRA Schneider, 1866

**CERATOSPIRA THRIPONAXIS Wehr, 1930.**

Eye of bird (*Thriponax* sp.). Exact locality not specified.
Reference: 220.

## Family ACUARIIDÆ Seurat, 1913

### Subfamily ACUARIINÆ Railliet, Henry and Sisoff, 1912

### Genus CHEILOSPIRURA Diesing, 1861

**CHEILOSPIRURA HAMULOSA (Diesing, 1851).**

*Dispharagus hamulosa* (DIESING, 1851).
*Acuaria hamulosa* (DIESING, 1851).

Gizzard of chicken. Intermediate hosts: grasshoppers (*Oxya sinensis* and *Aeolopus tamulus*). Manila and Los Baños, Laguna; Luzon.
References: 128, 175.

**CHEILOSPIRURA sp. Africa and Garcia, 1936.**

Conjunctiva of man. Biñan, Laguna, Luzon.
Reference: 12a.

### Genus DISPHARYNX Railliet, Henry and Sisoff, 1912

**DISPHARYNX SPIRALIS (Molin, 1858).**

*Dispharagus spiralis* MOLIN, 1858.
*Acuaria spiralis* RAILLIET, HENRY, and SISOFF, 1912.

Proventriculus of domestic chicken. Los Baños, Laguna, Luzon.
Reference: 175.

## Family RICTULARIIDÆ Railliet, 1916

### Subfamily RICTULARIINÆ Hall, 1913

### Genus RICTULARIA Froelich, 1802

**RICTULARIA PARADOXURI Tubangui and Masiluñgan, 1937.**

Intestine of civet (*Paradoxurus philippinensis*). Balanga, Bataan, Luzon.
Reference: 203.

**RICTULARIA WHARTONI Tubangui, 1931.**

Stomach and small intestine of rat (*Rattus norvegicus*). Manila, Luzon.
Reference: 182.

## Family TETRAMERIDÆ Travassos, 1914

### Subfamily TETRAMERINÆ Railliet, 1915

#### Genus TETRAMERES Creplin, 1846

**TETRAMERES FISSISPINA (Diesing, 1860).**

*Tropidocerca fissispina* DIESING, 1860.
*Tropisurus fissispinus* NEUMANN, 1888.

Proventriculus of chicken. Widely distributed.
References: 175, 225, 226.

## Superfamily FILARIOIDEA (Weinland, 1858) Stiles, 1907

## Family FILARIIDÆ (Cobbold, 1864) Claus, 1885

### Subfamily FILARIINÆ Stiles, 1907

#### Genus PARAFILARIA Yorke and Maplestone, 1926

**PARAFILARIA BOVICOLA Tubangui, 1934.**

In nodules in skin of cattle. Tanauan, Batangas, Luzon.
References: 85, 88, 188.

#### Genus HAMATOSPICULUM Skrjabin, 1916

**HAMATOSPICULUM DICRURI Tubangui, 1934.**

Under skin of head of bird (*Dicrurus hottentottus balicassius*). Novaliches, Rizal, Luzon.
Reference: 188.

**HAMATOSPICULUM LETICIAE Tubangui, 1934.**

Under skin of head and neck of bird (*Halcyon chloris*). Novaliches, Rizal, Luzon.
Reference: 188.

**HAMATOSPICULUM OTOMELARUM Tubangui, 1934.**

Under skin of head and neck and between trachea and œsophagus of bird (*Otomela lucionensis*). Baao, Camarines Sur, Luzon.
Reference: 188.

### Subfamily DIPLOTRIAENINÆ Skrjabin, 1916

#### Genus DIPLOTRIAENA Railliet and Henry, 1909

**DIPLOTRIAENA CORRUGATA Wehr, 1930.**

Probably body cavity of bird (*Ptilopyga basilanica basilanica*). Exact locality not specified.
Reference: 220.

**DIPLOTRIAENA PYCNONOTI Tubangui, 1934.**

Subcutaneous tissue of bird (*Pycnonotus goiavier goiavier*). Sipocot, Camarines Sur, Luzon.
Reference: 188.

Subfamily DICHEILONEMATINÆ Wehr, 1935

Genus SERRATOSPICULUM Skrjabin, 1916

**SERRATOSPICULUM THORACIS Tubangui, 1934.**

*Squamofilaria thoracis* of CHITWOOD and CHITWOOD, 1938.

Walls of thoracic and abdominal cavities of bird (*Falco peregrinus ernesti*). Manila, Luzon.

References: 45a, 188.

Genus SETARIA Viborg, 1795

**SETARIA EQUINA (Abildgaard, 1789).**

Abdominal cavity and cæcum of horse. Widely distributed.

References: 49a, 156, 174.

**SETARIA LABIATO-PAPILLOSA (Alessandrini, 1838).**

*Filaria cervina* DUJARDIN, 1845.
*Filaria labiato-papillosa* ALESSANDRINI, 1838.
*Filaria papillosa* of PHALEN and NICHOLS, 1909.

Abdominal cavity and rumen of cattle. Widely distributed.

References: 38, 88, 122, 150, 163, 174.

Subfamily APROCTINÆ Yorke and Maplestone, 1926

Genus APROCTA von Linstow, 1883

**APROCTA ROTUNDATA (von Linstow, 1903).**

Intestine of bird (*Centropus viridis*). Exact locality not specified.

Reference: 154.

Genus CHANDLERELLA Yorke and Maplestone, 1926

**CHANDLERELLA LEPIDOGRAMMI Tubangui and Masilungan, 1937.**

Coelom of bird (*Lepidogrammus cumingi*). Virac, Albay, Luzon.

Reference: 203.

## Family ACANTHOCHEILONEMATIDÆ Faust, 1939

Subfamily ACANTHOCHEILONEMATINÆ Faust, 1939

Genus WUCHERERIA Da Silva Araujo, 1877

**WUCHERERIA BANCROFTI (Cobbold, 1877) Seurat, 1921.**

*Filaria bancrofti* COBBOLD, 1877.
*Microfilaria bancrofti* (COBBOLD, 1877).
*Filaria nocturna* MANSON, 1891.
*Filaria philippinensis* ASHBURN and CRAIG, 1906.

Adults in lymphatic vessels and lymph glands; free microfilariæ in lymph and blood stream, of man. Mosquito vector:

*Culex quinquefasciatus.* Bicol Provinces and other places in Luzon; Samar; Leyte; Bohol; Negros Occidental; Iloilo; Mindanao.

References: 1, 18, 29, 30, 30a, 39b, 74, 98, 116, 120, 121, 122, 163, 217, 228a.

Subfamily DIROFILARIINÆ Wehr, 1935

Genus **DIROFILARIA** Railliet and Henry, 1911

**DIROFILARIA IMMITIS** (Leidy, 1856).

*Wuchereria immitis* of ST. JOHN and SIMMONS, 1931.

Heart and pulmonary artery of dog. Mosquito vectors: *Culex quinquefasciatus* and *Aedes aegypti.* Widely distributed.

References: 122, 138, 154, 164, 174.

Subfamily ONCHOCERCINÆ Leiper, 1911

Genus **ELAEOPHORA** Railliet and Henry, 1912

**ELAEOPHORA POELI** (Vryburg, 1897).

Aorta of cattle and carabao. Widely distributed.

References: 88, 150.

FILARIOIDEA INSUFFICIENTLY KNOWN

**MICROFILARIA** of Dy and Soriano, 1940.

Blood stream of domestic chicken. Manila, Luzon.

Reference: 52.

## Class NEMATOMORPHA (Vejdovsky, 1886) Ritchie, 1915

## Subclass GORDIACEA von Siebold, 1848

### Family CHORDODIDÆ May, 1920

Genus **CHORDODES** Creplin, 1847

**CHORDODES ORNATUS** (Grenacher, 1868).

*Gordius ornatus* GRENACHER, 1868.

Presumably body cavity of Mantis. Exact locality not specified.

Reference: 73.

Genus **PARAGORDIUS** Camerano, 1897

**PARAGORDIUS VARIUS** (Leidy, 1851).

Only free-living stage known. Exact locality not specified.

Reference: 154.

PHYLUM UNCERTAIN

## Class ACANTHOCEPHALA Rudolphi, 1808

### Order PALAEACANTHOCEPHALA (Meyer, 1931)

### Family RHADINORHYNCHIDÆ Travassos, 1923

#### Genus FILISOMA Van Cleave, 1928

**FILISOMA RIZALINUM Tubangui and Masiluñgan, 1946.**

Intestine of fish (*Scatophagus argus*). Malabon, Rizal, Luzon.

Reference: 207.

### Family POLYMORPHIDÆ Meyer, 1931

#### Subfamily POLYMORPHINÆ Meyer, 1931

#### Genus POLYMORPHUS Luehe, 1911

**POLYMORPHUS FRONTOSPINOSUS Tubangui, 1935.**

Intestine of bird (*Nycticorax nycticorax nycticorax*). Novaliches, Rizal, Luzon.

Reference: 189.

#### Subfamily CENTRORHYNCHINÆ (Van Cleave, 1916)

#### Genus CENTRORHYNCHUS Luehe, 1911

**CENTRORHYNCHUS INSULARIS Tubangui, 1933.**

Intestine of birds (*Haliastur indus intermedius, Butastur indicus,* and *Spilornis cheela palawanensis*). Novaliches, Rizal and Iriga, Camarines Sur, Luzon; Palo, Leyte.

Reference: 186.

#### Genus PSEUDOPORRORCHIS Joyeux and Baer, 1935

**PSEUDOPORRORCHIS CENTROPUSI (Tubangui, 1933).**

*Echinorhynchus centropusi* TUBANGUI, 1933.

Intestine of birds (*Centropus viridis* and *Dasylophus superciliosus*). Novaliches, Rizal and Los Baños, Laguna; Luzon.

References: 89, 186.

#### Subfamily PLAGIORHYNCHINÆ Meyer, 1931

#### Genus PROSTHORHYNCHUS Kostylew, 1915

**PROSTHORHYNCHUS LIMNOBAENI Tubangui, 1933.**

Intestine of bird (*Porzana fusca fusca*). Novaliches, Rizal, Luzon.

Reference: 186.

**PROSTHORHYNCHUS PITTARUM Tubangui, 1935.**

Intestine of bird (*Pitta atricapilla*). Novaliches, Rizal, Luzon.

Reference: 189.

**Genus OLIGOTERORHYNCHUS Monticelli, 1914**

**OLIGOTERORHYNCHUS MALAYENSIS Tubangui, 1935.**

Intestine of bird (*Rallus rallus philippensis*). Novaliches, Rizal, Luzon.

Reference: 189.

Family DIPLOSENTIDÆ Tubangui and Masiluñgan, 1937

**Genus DIPLOSENTIS Tubangui and Masiluñgan, 1937**

**DIPLOSENTIS AMPHACANTHI Tubangui and Masiluñgan, 1937.**

Intestine of fish (*Amphacanthus oramin*). Mucielagos Bay, Mindanao.

Reference: 201.

Family LEIPERACANTHIDÆ Bhalerao, 1937

**Genus LEIPERACANTHUS Bhalerao, 1937**

**LEIPERACANTHUS GALLINARUM Bhalerao, 1937.**

Intestine of domestic chicken. Manila, Luzon.

Reference: 207.

**Order ARCHIACANTHOCEPHALA (Meyer, 1931)**

Family GIGANTORHYNCHIDÆ Hamann, 1892

**Genus EMPODIUS Travassos, 1916**

**EMPODIUS TURNIXENA Tubangui, 1933.**

Intestine of bird (*Turnix ocellata*). Novaliches, Rizal, Luzon.

Reference: 186.

**Genus MEDIORHYNCHUS (Van Cleave, 1916)**

**MEDIORHYNCHUS SIPOCOTENSIS Tubangui, 1935.**

Intestine of bird (*Penelopides panini manillae*). Sipocot, Camarines Sur, Luzon.

Reference: 189.

Family MONILIFORMIDÆ Van Cleave, 1924

**Genus MONILIFORMIS Travassos, 1915**

**MONILIFORMIS MONILIFORMIS (Bremser, 1811).**

Intestine of rat (*Rattus norvegicus*). Widely distributed.

References: 154, 182.

## Family OLIGACANTHORHYNCHIDÆ Southwell and Macfie, 1925

### Genus OLIGACANTHORHYNCHUS Travassos, 1915

**OLIGACANTHORHYNCHUS POMATOSTOMI (Johnston and Cleland, 1911).**

*Echinorhynchus pomatostomi* JOHNSTON and CLELAND, 1911.

Under skin of neck of birds (*Rallus rallus philippensis* and *Excalfactoria chinensis lineata*). Novaliches, Rizal, Luzon.

Reference: 186.

### Genus MACRACANTHORHYNCHUS Travassos, 1916

**MACRACANTHORHYNCHUS HIRUDINACEUS (Pallas, 1781).**

Intestine of domestic pig and wild pig (*Sus philippensis*). Widely distributed.

References: 49a, 151.

### Genus NEPHRIDIORHYNCHUS Meyer, 1931

**NEPHRIDIORHYNCHUS PALAWANENSIS Tubangui and Masilungan, 1938.**

Intestine of pangolin (*Manis javanica*). Palawan.

Reference: 204.

## Order EOACANTHOCEPHALA Van Cleave, 1936

## Suborder NEOACANTHOCEPHALA Van Cleave, 1936

## Family NEOECHINORHYNCHIDÆ Van Cleave, 1919

### Genus NEOECHINORHYNCHUS Hamann in Stiles and Hassall, 1904

**NEOECHINORHYNCHUS OCTONUCLEATUS Tubangui, 1933.**

Intestine of fresh-water fish (*Therapon argenteus*). Los Baños, Laguna, Luzon.

Reference: 186.

## LIST OF HOSTS AND THEIR PARASITES

### MAMMALS

Man (*Homo sapiens* Linnæus):

*Ancylostoma braziliense.*
*Ancylostoma caninum.*
*Ancylostoma duodenale.*
*Ascaris lumbricoides.*
*Bertiella studeri.*
*Cheilospirura* sp.
*Clonorchis sinensis.*
*Diorchitrema pseudocirrata.*
*Diphyllobotrium latum.*
*Dipylidium caninum.*
*Echinococcus granulosus.*
*Echinostoma ilocanum.*
*Enterobius vermicularis.*
*Fasciola gigantica.*
*Fasciola hepatica.*
*Fasciolopsis buski.*
*Gastrodiscoides hominis.*
*Haplorchis calderoni.*
*Haplorchis taichui.*
*Haplorchis vanissima.*

Man (*Homo sapiens* Linnæus)—Continued.

*Haplorchis yokogawai.*
*Hymenolepis diminuta.*
*Hymenolepis nana.*
*Necator americanus.*
*Paragonimus westermani.*
*Plagiorchis philippinensis.*
*Raillietina (Raillietina) garrisoni.*
*Raillietina (Raillietina) madagascariensis.*
*Schistosoma japonicum.*
*Sparganum* sp.
*Spelotrema brevicaeca.*
*Strongyloides stercoralis.*
*Syngamus laryngeus.*
*Syphacia obvelata.*
*Taenia (Taenia) solium.*
*Taenia (Taeniarhynchus) saginata.*
*Trichuris trichiura.*
*Wuchereria bancrofti.*

Monkey [*Pithecus philippinensis* (Geoffroy)]:
(= *Macacus cynomolgus* Thomas).

*Bertiella studeri.*
*Haplorchis yokogawai.*
*Oesophagostomum bifurcum.*
*Schistosoma japonicum.*
*Subulura cynomolgi.*

Cat (*Felis catus domesticus* Linnæus):

*Ancylostoma braziliense.*
*Ancylostoma caninum.*
*Centrocestus formosanus.*
*Clinostomum abdoni.*
*Diorchitrema pseudocirrata.*
*Diphyllobothrium mansoni.*
*Dipylidium caninum.*
*Gnathostoma spinigerum.*
*Haplorchis calderoni.*
*Haplorchis pumilio.*
*Haplorchis sisoni.*
*Haplorchis taichui.*
*Haplorchis yokogawai.*
*Heterophyopsis expectans.*
*Microlistrum* sp.
*Opisthorchis wardi.*
*Paragonimus westermani.*
*Physaloptera pacitae.*
*Pygidiopsis genata.*
*Schistosoma japonicum.*
*Stictodora guerreroi.*
*Stictodora manilensis.*
*Stictodora sawakinensis.*
*Taenia (Hydatigera) taeniaformis.*
*Toxocara cati.*

Dog (*Canis familiaris* Linnæus):

*Ancylostoma braziliense.*
*Ancylostoma caninum.*
*Apophallus eccentricus.*
*Bertiella studeri.*
*Centrocestus formosanus.*
*Chlamydonema praeputiale.*
*Diorchitrema pseudocirrata.*
*Diphyllobothrium mansoni.*
*Dipylidium buencaminoi.*
*Dipylidium caninum.*
*Dirofilaria immitis.*
*Echinococcus granulosus.*
*Gnathostoma spinigerum.*
*Haplorchis calderoni.*
*Haplorchis pumilio.*
*Haplorchis sisoni.*
*Haplorchis taichui.*
*Haplorchis yokogawai.*
*Heterophyopsis expectans.*
*Pygidiopsis genata.*
*Pygidiopsis marivillai.*
*Schistosoma japonicum.*
*Spirocerca lupi.*
*Stictodora guerreroi.*
*Stictodora manilensis.*
*Stictodora palmifera.*
*Stictodora sawakinensis.*
*Taenia (Taenia) hydatigena.*
*Taenia (Taenia) pisiformis.*
*Toxascaris leonina.*
*Toxocara canis.*
*Trichuris vulpis.*

Civet (*Paradoxurus philippinensis* Jourdan):

*Gnathostoma spinigerum.*
*Molineus asiaticus.*
*Rictularia paradoxuri.*
*Sparganum philippinensis.*
*Uncinaria philippinensis.*

Squirrel Rat [*Crateromys schadenbergi* (Meyer)]:

*Gongylonema* sp.

Rat [*Rattus norvegicus* (Erxleben)]:

(= *Mus norvegicus* Erxleben).

*Capillaria hepatica.*
*Echinostoma guerreroi.*
*Echinostoma ilocanum.*
*Echinostoma murinum.*
*Gongylonema neoplasticum.*
*Heterakis spumosa.*
*Hymenolepis diminuta.*
*Hymenolepis nana.*
*Moniliformis moniliformis.*
*Nippostrongylus muris.*
*Plagiorchoides potamonides.*[2]
*Paragonimus westermani.*
*Protospirura muricola.*
*Raillietina (Raillietina) garrisoni.*
*Rictularia whartoni.*
*Schistosoma japonicum.*
*Strongyloides ratti.*
*Syphacia obvelata.*
*Taenia (Hydatigera) taeniaformis.*
*Trichosomoides crassicauda.*

Domesticated Pig (*Sus scrofa domesticus* Linnæus):

*Ascaris lumbricoides.*
*Ascarops strongylina.*
*Globocephalus longemucronatus.*
*Globocephalus samoensis.*
*Globocephalus urosubulatus.*
*Gnathostoma doloresi.*
*Gnathostoma hispidum.*
*Hyostrongylus rubidus.*
*Macracanthorhynchus hirudinaceus.*
*Metastrongylus elongatus.*
*Metastrongylus salmi.*
*Necator americanus.*
*Oesophagostomum dentatum.*
*Oesophagostomum longicaudum.*
*Physocephalus sexalatus.*
*Schistosoma japonicum.*
*Stephanurus dentatus.*
*Strongyloides suis.*
*Taenia (Taenia) hydatigena.*
*Taenia (Taenia) solium.*
*Trichuris trichiura.*

Wild Pig (*Sus philippensis* Nehring):

*Macracanthorhynchus hirudinaceus.*

Cattle (*Bos taurus* Linnæus):

*Bunostomum phlebotomum.*
*Bunostomum trigonocephalum.*
*Carmyerius gregarius.*
*Cotylophoron cotylophorum.*
*Dicrocoelium dendriticum.*
*Dictyocaulus viviparus.*
*Echinococcus granulosus.*
*Elaeophora poeli.*
*Eurytrema ovis.*
*Fasciola gigantica.*
*Fasciola hepatica.*
*Fasciolopsis* sp.
*Fischoederius elongatus.*
*Gastrothylax crumenifer.*
*Haemonchus contortus.*
*Homalogaster paloniae.*
*Mecistocirrus digitatus.*
*Moniezia benedeni.*
*Moniezia expansa.*
*Neoascaris vitulorum.*
*Oesophagostomum columbianum.*
*Oesophagostomum radiatum.*
*Oesophagostomum* sp.
*Parafilaria bovicola.*
*Paramphistomum anisocotylea.*
*Paramphistomum cervi.*

[2] From a laboratory white rat.

Cattle (*Bos taurus* Linnæus)—Continued.

*Paramphistomum explanatum.*
*Paramphistomum* sp.
*Schistosoma japonicum.*
*Setaria labiato-papillosa.*
*Syngamus laryngeus.*
*Taenia* (*Taeniarhynchus*) *saginata.*
*Thelazia rhodesi.*
*Trichuris ovis.*

Carabao (*Bubalus bubalis* Linnæus):

*Avitellina bubalinae.*
*Carmyerius gregarius.*
*Cotylophoron cotylophorum.*
*Echinococcus granulosus.*
*Elaeophora poeli.*
*Fasciola gigantica.*
*Fasciola hepatica.*
*Fischoederius elongatus.*
*Gastrothylax crumenifer.*
*Moniezia benedeni.*
*Neoascaris vitulorum.*
*Paramphistomum anisocotylea.*
*Paramphistomum explanatum.*
*Schwartziella nodulosa.*
*Syngamus laryngeus.*

Sheep (*Ovis aries* Linnæus):

*Bunostomum phlebotomum.*
*Bunostomum trigonocephalum.*
*Eurytrema ovis.*
*Fasciola gigantica.*
*Fasciola hepatica.*
*Haemonchus contortus.*
*Moniezia expansa.*
*Moniezia trigonophora.*
*Oesophagostomum columbianum.*
*Trichuris ovis.*

Goat (*Capra hircus* Linnæus):

*Bunostomum phlebotomum.*
*Bunostomum trigonocephalum.*
*Fasciola gigantica.*
*Fasciola hepatica.*
*Haemonchus contortus.*
*Moniezia expansa.*
*Oesophagostomum columbianum.*
*Oesophagostomum radiatum.*
*Oesophagostomum venulosum.*
*Schistosoma japonicum.*
*Trichuris ovis.*

Horse (*Equus caballus* Linnæus):

*Anoplocephala mamillana.*
*Anoplocephala perfoliata.*
*Gyalocephalus capitatus.*
*Habronema megastoma.*
*Habronema microstoma.*
*Habronema muscae.*
*Oesophagodontus robustus.*
*Oxyuris equi.*
*Parascaris equorum.*
*Poteriostomum imparidentatum.*
*Poteriostomum ratzii.*
*Probstmayria vivipara.*
*Schistosoma japonicum.*
*Setaria equina.*
*Strongylus* (*Alfortia*) *edentatus.*
*Strongylus* (*Delafondia*) *vulgaris.*
*Strongylus* (*Strongylus*) *equinus.*
*Trichonema auriculatum.*
*Trichonema bicoronatum.*
*Trichonema calicatum.*
*Trichonema catinatum.*
*Trichonema catinatum* var. *pseudocatinata.*
*Trichonema coronatum.*
*Trichonema elongatum.*
*Trichonema euproctum.*
*Trichonema goldi.*
*Trichonema goldi* var. *tridentata.*
*Trichonema insigne.*
*Trichonema labiatum.*
*Trichonema leptostomum.*
*Trichonema longibursatum.*
*Trichonema minutum.*
*Trichonema nassatum.*
*Trichonema nassatum* var. *parva.*
*Trichonema pateratum.*
*Trichonema radiatum.*
*Trichonema ultrajectinum.*
*Triodontophorus minor.*
*Triodontophorus serratus.*

Bat [*Scotophilus temminckii* (Horsfield)]:

*Platynosomum philippinorum.*
*Prosthodendrium ovimagnosum.*
*Prosthodendrium luzonicum.*

Flying Lemur [*Cyanocephalus volans* (Linnæus)]:

(= *Galeopithecus philippinensis* Waterhouse).

*Auchenacantha boholi.*
*Auchenacantha hoepplii.*
*Auchenacantha corollata.*

Dugong (*Dugong dugon* Mueller):

*Opisthotrema dujonis.*

Pangolin (*Manis javanica* Desmarest):

*Nephridiorhynchus palawanensis.*

BIRDS

Wild Chicken (*Gallus gallus gallus* Linnæus):

*Raillietina* (*Paroniella*) *tinguiana.*

Domestic Chicken (*Gallus gallus domesticus* Linnæus):

*Amoebotaenia sphenoides.*
*Ascaridia compar.*
*Ascaridia galli.*
*Brachylaemus malayensis.*
*Capillaria annulata.*
*Capillaria retusa.*
*Cheilospirura hamulosa.*
*Cotugnia digonophora.*
*Cotugnia* sp.
*Davainea proglottina.*
*Dispharynx spiralis.*
*Echinostoma revolutum.*
*Episthmium gallinum.*
*Gongylonema ingluvicola.*
*Heterakis beramporia.*
*Heterakis gallinae.*
*Hymenolepis carioca.*
*Leiperacanthus gallinarum.*
*Microfilaria* sp.
*Notocotylus intestinalis.*
*Oxyspirura mansoni.*
*Philophthalmus problematicus.*
*Prosthogonimus cuneatus.*
*Prosthogonimus pseudopellucidus.*
*Raillietina* (*Fuhrmannetta*) *echinobothrida.*
*Raillietina* (*Raillietina*) *tetragona.*

Quail [*Excalfactoria chinensis lineata* (Scopoli)]:

*Oligacanthorhynchus pomatostomi.*

Button Quail [*Turnix ocellata* (Scopoli)]:

*Empodius turnixena.*

Pigeon (*Treron* sp.):

*Raillietina* (*Raillietina*) *daetensis.*

Turtle Dove [*Streptopelia bitorquata dussumieri* (Temminck)]:

*Aporina delafondi.*
*Raillietina* (*Raillietina*) *sequens.*
*Cotugnia ilocana.*

Domestic Pigeon (*Columba livia domestica* Linnæus):

*Cotugnia rimandoi.*
*Tamerlania bragai.*
*Raillietina* (*Raillietina*) *torquata* var. *rajae.*

Rail [*Rallus rallus striatus* (Linnæus)]:

[= *Hypotaenidia striata* (Linnæus)].

*Leucochloridium hypotaenidiarum.* *Metorchis caintaensis.*

Rail [*Rallus rallus philippensis* (Linnæus)]:

[= *Hypotaenidia philippensis* (Linnæus)].

*Metorchis caintaensis.* *Oligoterorhynchus malayensis.*
*Oligacanthorhynchus pomatostomi.* *Stomylotrema rotunda.*

Rail (*Rallus rallus torquatus* Linnæus):

[= *Hypotaenidia torquata* (Linnæus)].

*Echinochasmus novalichesensis.*

Crake [*Rallina eurizonoides eurizonoides* (Lafresnaye)]:

*Glaphyrostomum rallinarum.*

Crake [*Porzana fusca fusca* (Linnæus)]:

[= *Limnobaenus fuscus* (Linnæus)].

*Prosthorhynchus limnobaeni.*

Moorhen (*Gallinula chloropus lozanoi* Lletget):

*Diorchis visayana.* *Echinostoma chloropodis* var. *philippinensis.*
*Echinostoma batanguensis.*

Tern (*Sterna albitrons sinensis* Gmelin):

*Spelotrema brevicaeca.* *Tetracotyle bicolandiae.*

Laughing Gull (*Larus ridibundus* Linnæus):

*Stictodora guerreroi.* *Stictodora manilensis.*

Plover [*Pluvialis dominica fulva* (Gmelin)]:

(= *Charadrius fulvus* Gmelin).

*Echinostoma charadrii.*

Plover [*Ochthodromus mongolus mongolus* (Pallas)]:

*Acanthoparyphium ochthodromi.* *Gyrocoelia paradoxa.*

Redshank [*Tringa totanus eurhinus* (Oberholser)]:

[= *Totanus eurhinus* (Oberholser)].

*Cyclocoelium* (*Postpharyngeum*) *orientale* var. *eurhina.*

Snipe [*Capella gallinago gallinago* (Linnæus)]:

[= *Gallinago gallinago* (Linnæus)].

*Austrobilharzia bayensis.* *Pseudapatemon mamilliformis.*

Snipe [*Capella gallinago megala* (Swinhoe)]:

(= *Gallinago megala* Swinhoe).

*Haploparaxis sanjuanensis.*

Snipe [*Rostratula benghalensis benghalensis* (Linnæus)]:
*Fuhrmanniella clerci.*

Heron (*Ardea purpurea manilensis* Meyen):
[= *Pyrrherodia manilensis* (Meyen)].
*Centrocestus formosanus.* *Haplorchis yokogawai.*

Egret [*Herodias timoriensis* (Lesson)]:
*Nephrostomum bicolanum.*

Egret [*Bubulcus ibis coromandus* (Boddaert)]:
*Centrocestus formosanus.* *Posthodiplostomum larai.*
*Haplorchis taichui.* *Nephrostomum bicolanum.*
*Haplorchis yokogawai.* *Pegosomum bubulcum.*

Night Heron [*Nycticorax nycticorax nycticorax* (Linnæus)]:
*Polymorphus frontospinosus.*

Lesser Man-O'-War Bird [*Fregata ariel ariel* (Grey)]:
*Heterophyopsis expectans.* *Mesostephanus fregatus.*

Monkey-eating Eagle [*Pithecophaga jefferyi* (Grant)]:
*Phagicola pithecophagicola.*

Serpent Eagle [*Spilornis cheela palawanensis* (Selster)]:
[= *Spilornis bacha* (Daudin)].
*Centrorhynchus insularis.*

Tic-Wee Buzzard [*Butastur indicus* (Gmelin)]:
*Centrorhynchus insularis.* *Parastrigea intermedia.*
*Kowalewskiella buzzardia.* *Strigea mcgregori.*
*Neodiplostomum butasturinum.*

Sea Eagle [*Haliæetus leucogaster* (Gmelin)]:
*Pygidiopsis marivillai.*

Kite (*Haliastur indus intermedius* Blyth):
*Centrorhynchus insularis.* *Mesostephanus haliasturus.*

Falcon (*Falco peregrinus ernesti* Sharpe):
*Serratospiculum thoracis.*

Barred Owl [*Strix whiteheadi* (Sharpe)]:
*Haplorchis yokogawai.*

Grass Owl [*Aluco longimembris* (Jerdon)]:
*Neodiplostomum aluconis.*

Kingfisher [*Halcyon chloris* (Boddaert)]:
*Hamatospiculum leticiae.*

Tarictic [*Penelopides panini manillae* (Boddaert)]:
*Mediorhynchus sipocotensis.*

Red-winged Coucal [*Centropus viridis* (Scopoli)]:
*Aprocta rotundata.* *Pseudoporrorchis centropusi.*

Rough-crested Cuckoo [*Dasylophus superciliosus* (Cuvier)]:
*Brachylaemus* sp. *Pseudoporrorchis centropusi.*
*Leucochloridium dasylophi.*

Cuckoo [*Lepidogrammus cumingi* (Fraser)]:
*Chandlerella lepidogrammi.*

Cuckoo sp.
*Ascaridia subequalis.*

Woodpecker [*Lichtensteinipicus funebris* (Valenciennes)]:
*Raillietina (Paroniella) cirroflexa.*

Woodpecker (*Thriponax* sp.):
*Ceratospira thriponaxis.* *Thelazia philippinensis.*

Black-headed Pitta (*Pitta atricapilla* Lesson):
*Prosthorhynchus pittarum.*

Bulbul [*Iole philippinensis philippinensis* (Gmelin)]:
[= *Iole gularis* (Pucheran)].
*Hymenolepis* sp.

Guava Bulbul [*Pycnonotus goiavier goiavier* (Scopoli)]:
*Diplotriaena pycnonoti.* *Raillietina (Paroniella) bulbularum.*
*Hymenolepis pycnonoti.*

Babbler [*Ptilopyga basilanica basilanica* (Steere)]:
*Diplotriaena corrugata.*

Shrike [*Otomela lucionensis* (Linnæus)]:
*Hamatospiculum otomelarum.*

Oriole (*Oriolus chinensis chinensis* Linnæus):
(= *Oriolus acrorhynchus* Vigors).
*Raillietina (Paroniella) culiauana.*

Drongo [*Dicrurus hottentottus balicassius* (Linnæus)]:
*Hamatospiculum dicruri.*

Philippine Crow (*Corvus coronoides philippinus* Bonaparte):
[= *Corone philippina* (Bonaparte)].
*Hymenolepis coronoidis.* *Raillietina (Paroniella) coronea.*

Domesticated Duck [*Anas boschas domestica* (Linnæus)]:
*Echinoparyphium recurvatum.* *Notocotylus naviformis.*
*Echinostoma revolutum.* *Philophthalmus rizalensis.*
*Notocotylus intestinalis.* *Psilochasmus longicirratus.*

REPTILES

Crocodile (*Crocodilus porosus* Schneider):

*Acanthostomum atae.*
*Acanthostomum elongatus.*
*Harmotrema rudolphii.*
*Pseudoneodiplostomum crocodilarum.*

Turtle [*Cyclemis amboinensis* (Daudin)]:

*Cercorchis cyclemidis.*
*Spironoura duyagi.*

Python [*Python reticulatus* (Schneider)]:

*Bothridium pithonis.*
*Styphlodora renalis.*

Cobra (*Naja naja philippinensis* Taylor):

*Harmotrema eugari.*
*Kalicephalus* sp.

Water Snake (*Lapemis hardwickii* Gray):

*Opisthorchis ophidiarum.*

Monitor [*Varanus salvator* (Laurenti)]:

*Duthiersia fimbriata.*
*Euparadistomum varani.*
*Scyphocephalus secundus.*

Aquatic Lizard [*Hydrosaurus pustulosus* (Eschscholtz)]:

*Cissophyllus leytensis.*
*Paradistomum paloensis.*

Lizard (*Mabuya multifasciata* Kuhl):

*Mesocoelium meggitti.*
*Oochoristica excelsa.*

Lizard [*Calotes marmoratus* (Gray)]:

*Paradistomum excalotes.*

House Lizard (*Hemidactylus frenatus* Dumeril and Bibron):

*Paradistomum gregarinum.*
*Posthorchigenes ovatus.*

AMPHIBIANS

Frog (*Rana vittigera* Wiegmann):

*Diphyllobothrium mansoni.*
*Diplodiscus amphichrus.*
*Glypthelmins staffordi.*
*Pleurogenoides taylori.*

Frog (*Rana magna* Stejneger):

*Clinostomum pseudoheterostomum.*
*Oxysomatium ranae.*
*Physaloptera amphibia.*

FISHES

Eel (*Anguilla mauritiana* Bleeker):

*Bothriocephalus travassosi.*
*Galactosomum anguillarum.*

Catfish (*Arius manillensis* Cuvier and Valenciennes):

*Opegaster minimus.*

Hito [*Clarias batrachus* (Linnæus)]:

*Opegaster minimus.*
*Orientocreadium batrachoides.*

Halfbeak (*Hemiramphus georgii* Cuvier and Valenciennes):

*Haplorchis calderoni.*
*Haplorchis yokogawai.*
*Heterophyopsis expectans.*
*Stictodora guerreroi.*

Mudfish (*Ophicephalus striatus* Bloch):

*Centrocestus formosanus.*
*Clinostomum dalagi.*
*Clinostomum ophicephali.*
*Euclinostomum multicaecum.*
*Gnathostoma spinigerum.*
*Haplorchis calderoni.*
*Haplorchis pumilio.*
*Haplorchis taichui.*
*Haplorchis yokogawai.*
*Opegaster minimus.*

Perch [*Anabas testudineus* (Bloch)]:

*Centrocestus formosanus.*
*Diorchitrema pseudocirrata.*

Silverside (*Atherina balabacensis* Seale):

(= *Hepsetia balabacensis* Jordan and Hubbs).
*Haplorchis calderoni.*

Mullet (*Mugil* sp.):

*Diorchitrema pseudocirrata.*
*Haplorchis calderoni.*
*Haplorchis yokogawai.*
*Heterophyopsis expectans.*
*Pygidiopsis genata.*
*Pygidiopsis marivillai.*

Threadfin [*Eleutheronema tetradactylum* (Shaw)]:

*Haplorchis calderoni.*

Cavalla [*Caranx speciosus* (Forskal)]:

*Metabronema caranxi.*

*Scomberoides* sp.

*Ectenurus lemeriensis.*

*Ambassis buruensis* Bleeker:

*Haplorchis calderoni.*
*Haplorchis pumilio.*
*Haplorchis yokogawai.*
*Heterophyopsis expectans.*
*Microlistrum* sp.
*Stictodora guerreroi.*
*Stictodora manilensis.*

Sea Bass (*Anyperodon leucogrammicus* Cuvier and Valenciennes):

*Ancyrocephalus manilensis.*

Snapper (*Lutjanus* sp.):

(= *Lutianus lioglossus* of Tubangui, 1925).
*Ancyrocephalus manilensis.*
*Tetrancistrum lutiani.*

Grunt [*Pomadasys hasta* (Bloch)]:

(= *Pristipoma hasta* Guenther):
*Azygia pristipomai.*

*Therapon argenteus* (Cuvier and Valenciennes):

*Gnathostoma spinigerum.*
*Neoechinorhynchus octonucleatus.*
*Opegaster minimus.*

*Therapon plumbeus* (Kner):
*Centrocestus formosanus.* *Haplorchis pumilio.*
*Echinochasmus novalichesensis.* *Haplorchis sisoni.*

*Pelates quadrilineatus* (Bloch):
*Haplorchis calderoni.* *Stictodora manilensis.*
*Heterophyopsis expectans.*

*Sillago maculata* (Quoy and Gaimard):
*Stictodora palmifera.*

Silver Perch (*Gerris filamentosus* Cuvier and Valenciennes):
*Haplorchis calderoni.* *Heterophyopsis expectans.*
*Haplorchis pumilio.* *Stictodora manilensis.*

Silver Perch (*Gerris kapas* Bleeker):
*Haplorchis yokogawai.* *Heterophyopsis expectans.*

*Scatophagus argus* (Linnæus):
*Filisoma rizalinum.*

*Amphacanthus javus* (Linnæus):
(= *Teuthis javus* Bleeker).
*Haplorchis calderoni.* *Haplorchis yokogawai.*
*Haplorchis pumilio.* *Hexangium affinum.*

*Amphacanthus virgatus* Cuvier and Valenciennes:
(= *Teuthis virgata* Guenther).
*Ancyrocephalus manilensis.* *Microcotyle virgatarum.*

*Amphacanthus oramin* Bloch and Schneider:
*Diplosentis amphacanthi.*

*Lepidaplois mesothorax* (Bloch and Schneider):
*Scaphanocephalus adamsi.*

*Ophiocara aporos* Bleeker:
*Echinochasmus novalichesensis.*

Bia (*Glossogobius giurus* Buchanan-Hamilton):
*Azygia pristipomai.* *Haplorchis calderoni.*
*Centrocestus formosanus.* *Haplorchis pumilio.*
*Echinochasmus novalichesensis.* *Neochasmus microvatus.*
*Ectenurus lemeriensis.* *Opegaster minimus.*
*Gnathostoma spinigerum.* *Prosorhynchus triangularis.*

*Creisson validus* Jordan and Seale:
*Haplorchis calderoni.*

ARTHROPODS

River Crab [*Parathelphusa* (*Barythelphusa*) *mistio* (Rathbun)]:
*Paragonimus westermani.* *Plagiorchoides potamonides.*

*Cyclops* (*Encyclops*) *serrulatus* Fischer:

*Diphyllobothrium mansoni.* *Gnathostoma spinigerum.*

*Cyclops* (*Microcyclops*) *bicolor* G. O. Sars:

*Diphyllobothrium mansoni.* *Gnathostoma spinigerum.*

Cockroach (*Panesthia javanica* Serville):

*Aorurus philippinensis.* *Leidynema nocalum.*
*Blattophila sphaerolaima* var. *javanica.* *Leidynemella paracranifera.*
*Thelastoma palmettum.*

Mosquito (*Culex quinquefasciatus* Say):

(= *Culex fatigans* Wied.).

*Dirofilaria immitis.* *Wuchereria bancrofti.*

Mosquito [*Aedes aegypti* (Linnæus)]:

(= *Stegomyia fasciata* Fabricius).

*Dirofilaria immitis.*

Grasshopper [*Aeolopus tamulus* (Fabricius)]:

*Cheilospirura hamulosa.*

Grasshopper (*Oxya sinensis* Walker):

*Cheilospirura hamulosa.*

Mantis:

*Chordodes ornatus.*

SNAILS

*Lymnaea* (*Galba*) *philippinensis* Nevill:

*Fasciola gigantica.* *Fasciola hepatica.*

*Lymnaea* (*Radix*) *swinhoe* var. *quadrasi* Moellendorff:

(=*Lymnaea peregra* Mueller of Tubangui, 1932).

*Echinostoma murinum.* *Fasciola gigantica.*
*Echinostoma revolutum.*

*Mixas cumingiana* (Pfeiffer):

[= *Amphipeplea cumingiana* (Pfeiffer)].

*Fasciola gigantica.*

*Anisus* (*Gyraulus*) *convexiusculus* (Hutton):

(= *Gyraulus prashadi* Faustino).

*Echinostoma ilocanum.*

*Melania asperata philippinensis* Sowerby:

*Cercaria maquilingi.* *Cercaria melaniasperata.*

*Melania* sp.:

*Cercaria maquilingi.*
*Cercaria melaniasperata.*
*Cercaria parvomelaniae.*
*Cercaria philippindica.*

*Pila luzonica* (Reeve):

(= *Ampullaria lagunaensis* Bartsch).

*Cercaria dorsocauda.*
*Cercaria lagunaensis.*
*Cercaria maitimensis.*
*Cercaria rarissima.*
*Cercaria redicystica.*
*Echinostoma ilocanum.*

*Oncomelania quadrasi* (Moellendorff):

[= *Blanfordia quadrasi* (Moellendorff)].

(= *Oncomelania hydrobiopsis* Rench).

[= *Schistosomophora quadrasi* (Moellendorff)].

*Schistosoma japonicum.*

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# ERRATUM

VOLUME 76

No. 3 of the present volume, printed in 1944, was erroneously paged; the first page of this number should have followed the last page of No. 2. Therefore, to avoid confusion in the index to No. 1 and No. 3, pages 1–68 of the latter *should read* 157–224, and page 3 of the first article *should read* 159.

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[New names and new combinations are printed in *italics.*]

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